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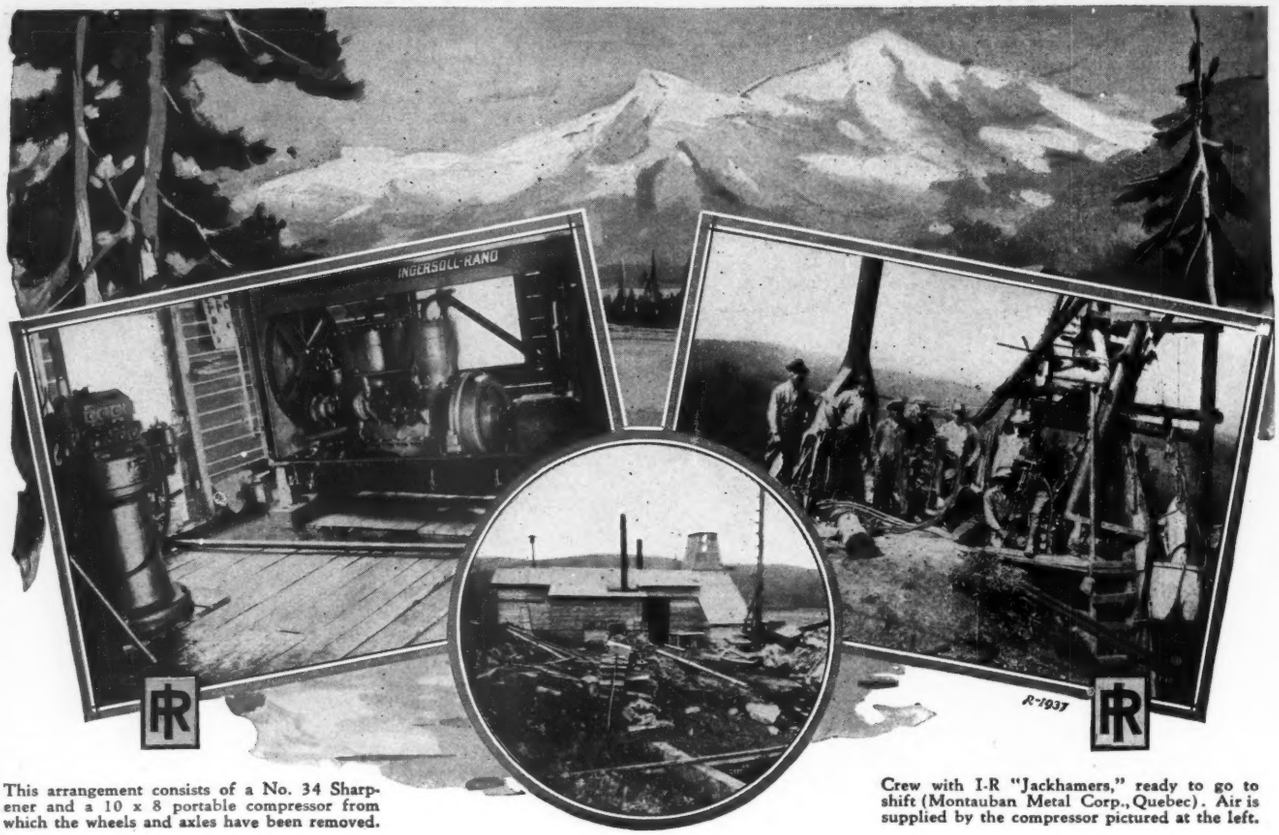

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A. W. ALLEN, *Editor*

Associate Editors: E. H. ROBIE, A. H. HUBBELL, New York. GEORGE J. YOUNG, San Francisco

Assistant Editors: W. N. P. REED and H. D. KEISER, New York. *Market Editor:* H. H. WANDERS. *Publishing Director:* H. W. CLARKE

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Mexican Mining Faces Further Handicaps

MEXICO has been blessed with bountiful natural resources, but its people have not been so prosperous as might have been expected. Political dissension has ruined any aspirations to national greatness that its inhabitants may have had. Profitable exploitation of resources has been effected largely by foreigners, and the backbone of the country's economic structure is dependent today on foreign capital. With these facts in mind, the proposed national labor law, of which Congressional discussion started on Sept. 1, would seem to forecast economic suicide. A constitutional amendment, already ratified by a majority of the states, gives the federal government power to legislate on many matters relating to labor that were formerly reserved to the states. Undoubtedly, the framers of the new law had in mind the fact that the road to prosperity depends on as wide a diffusion of riches as possible. High wages have been the inevitable concomitant of industrial progress in the United States. Employment, however, is a requisite for the payment of any wages, high or low.

Several months ago, Sr. Jenero Garcia, the president of the Mexican Mining Chamber, pointed out that under present operating conditions Mexico's mining industry is not earning 5 per cent on its capital, which is considered the minimum for profitable operation. An increase in labor costs, added to oppressive taxation and lower prices now prevailing for silver and lead and zinc, may cause the shutdown of several of the low-grade mines. Admitting that in many of its aims the new labor law is admirable, it is not, under present conditions in Mexico, practical. That, after all, is the final test.

Mining companies are uniformly against the proposed change, regardless of whether the properties are owned by Mexicans or by foreigners. New development work has almost stopped, and several properties are concentrating attention on producing all they can before the new law makes further operations impossible.

Mexico stands at the crossroads, where it has so frequently stood before. Not even the most sanguine of its statesmen can hope for any sudden improvement in the condition of its peoples. Confronted on the north by the spectacle of a nation that enjoys a high standard of living, its own political irresponsibility shackles natural progress. By passing a new and revolutionary labor law it takes the chance of further discouraging the investment of foreign capital to provide employment for its people.

Revolutions, even though they have the stamp of approval of Thomas Jefferson, who declared that one every few years was good for the morale of a nation—are not particularly attractive to capital. On the other hand, if the status of labor is allowed to remain as it is—though by comparison with other standards, one must admit that the status in Mexico is not particularly satisfactory—the government can turn attention to the more pressing problem of bringing a semblance of unity and order by the wider diffusion of education. Without advance in that direction no nation can hope to afford its workers the employment and living conditions to which they are entitled.

Capital cannot be stopped at the borders of a country. It will go where labor is efficient, even if expensive; or where it is cheap, even if inefficient. The Mexican government proposes to make labor expensive. It should first take steps to make it efficient.

An Untaught Factor in Achieving Success

THE editor of our McGraw-Hill contemporary, *Engineering News-Record,* makes pertinent comment in a recent issue anent the responsibility of the engineer to develop a co-operative spirit in his relations with his associates in whatever organization he decides to cast his lot. His professional training does little to encourage the development of this co-operative spirit, and he is likely to overlook its importance as a factor in progress when he is established in practice.

Engineers may be broadly classified into two types: those who work alone and those who work with others. Of the former, the ones who fondly believe that a reputation for wisdom can be achieved by the practice of a taciturnity are being speedily disillusioned. And those who feel that the rewards for initiative usually go astray, and that zeal is futile, are abandoning a philosophy that has brought scant satisfaction, mental or material. Who can say that he has given more than he has received? No one!

A group spirit insures individual success as well as organization prosperity. If the rewards fall with seeming disregard for justice, that is merely because no machinery is perfect. The machinery for the distribution of wealth and fame works with great eccentricity. It is easily tampered with and is far from foolproof. But the apparent injustice of today may be remedied, with interest, by the opportunities of tomorrow, provided the obstacle acts as an incentive and not as a hindrance to further effort. Nothing is to be gained by cheap cynicism directed against the inevitable, or by withdrawal into a shell of reserve. All worth-while effort is a com-

posite of the plans and achievements of a multitude of thinkers and doers. The brilliant idea that makes for commercial success may be no more than the touching of a match to a display of fireworks, or the throwing in of a switch to set giant machinery in motion. To disdain the value of help and counsel from others, and to refuse the benefit of co-operation with others, is to bar the way to a success that depends to a great extent on smooth human relationships.

Public-Lands Question Is Tackled by President Hoover

AT LAST the public-lands question, long agitated in the West, has received the attention of the Chief Executive, in an approach so positive that it promises definite results. Speaking through Assistant Secretary Dixon of the Interior Department at the recent meeting in Salt Lake City of public-land state governors, President Hoover declared that the Western states were much more competent than is the federal government to manage much of the affairs relating to the Public Lands and the Reclamation Service. "Moreover," he said, "we must seek every opportunity to retard the expansion of federal bureaucracy and to place our communities in control of their own destinies."

Transfer of the surface rights as well as the administration of the remaining unappropriated and unreserved public lands (about 200,000,000 acres, valuable in the main only for grazing purposes) to the state governments for public-school purposes was tentatively suggested by the President. Certain other suggestions with respect to the Reclamation Service were also made by Mr. Hoover, who declared that the administration of the service should be simplified and its direction reoriented primarily in regard to water storage.

Lands reserved for parks, forests, Indians, minerals, power sites, and other minor reserves, however, are not included among those proposed to be transferred. Mineral resources the President speaks of only to the extent of saying that in the policies to be pursued in conserving and developing them are presented many problems, among which are those offered by the abuse of permits for mineral development and by the unnecessary production or waste of minerals. Steps to prevent further abuse of prospecting have already been undertaken.

Those who have been demanding the transfer to the states of the public lands within their borders will surely feel that they are now about to see their efforts begin to bear some fruit. A prominent champion of state rights in this respect has been Governor Dern of Utah. He has expressed himself on this subject frequently in the past. With others he has made it plain that the West has a decided grievance; that, for instance, it does not like the present leasing law and resents the collection of royalties from the public lands by a federal landlord; that it resents the discrimination between the Eastern states, the public lands of which were long since disposed of and which are now a source of revenue to them through taxation, and those Western states wherein vast areas are not under state control and are therefore not subject to state taxation. In this respect, these champions maintain, the Western states are not sovereign within their respective boundaries.

Specifically, Governor Dern has said that when Utah became a state, four sections in each township within its borders were granted it by the enabling act, for the support of common schools. This would have yielded substantial revenue for the schools without taxation. But after the act was passed and the constitution adopted, the federal government began to undo the work of Congress by claiming that the lands known to be chiefly valuable for mineral had not been included in the grants—maintaining that, whereas the enabling act did not specifically reserve minerals, neither did it specifically grant them, with the result that they were reserved. This, Governor Dern has said, was the beginning of Utah's school-land problem. In contrast were states like Michigan and Minnesota, which on being admitted to statehood had received and been allowed to keep their minerals. Michigan had its copper and iron, and Minnesota its iron. Grievances of like sort are nursed by the other states that have public lands.

President Hoover's action will therefore be hailed as betokening a change of policy with respect to public lands. At the same time, many will be disappointed, feeling that it does not go far enough, inasmuch as only the surface rights of the 200,000,000 acres are involved. Such critics will do well to remember the adage that some bread is better than none, and to bear in mind that if they wait patiently, and at the same time make all the noise they can, they may get the entire loaf eventually.

Classical Scholarship and Modern Publishing

A COMMUNICATION was recently published in *Engineering and Mining Journal* in which the Greek derivation of "protore" was presented. This willingness to cater to erudition and to indicate to our readers the wide range of type fonts in the composing room brought, alas, nothing but trouble. The compositor turned **ό** (accented omicron) into **σ** (sigma), and the proofreader failed to detect the error. Several subscribers, however, were more alert, one pointing out misplaced accents and other barbarisms, in addition to the omicron-sigma substitution. His communication, carrying the stamp of authority, was duly sent to the composing room, whence it returned more "pi'd" than ever. Not only had accented omicrons become sigmas, but accented eta's came back pi's. Throwing up our hands, we resolved not to print a correction that held so little promise of being published correctly. And our resolution was proved to have been wise when this correspondent sent another letter correcting his correction!

Seldom are the problems that arise in publishing *Engineering and Mining Journal* as intriguing as this one. An adequate solution might be had, perhaps, by assembling a complete collection of Greek type, educating a compositor in the ancient language, and retaining two or three professors of Greek as consultants on the correct placing of accents. But, having taken such precautions, some ardent philologist among our readers

might trace the Greek back to the original Sanskrit and initiate a debate on original forms. Then all our efforts would have to be duplicated for another dead tongue. Moreover, we are not in the enviable position of those medieval scholars who could devote the major portion of their lives to the doctrine of the enclitic *de*. Modern publishing demands speed, and although perfection remains the ideal for which we strive, all we can hope to achieve is maximum accuracy compatible with the speed enforced on us. So, once again, things cultural must give way before the tempo of present-day business. Or, to be more outspoken, Greek will continue to be Greek to us.

Bibliographies of Minor Importance in Research Endeavor

PREPARATION and study of a bibliography prior to the physical initiation of a research program would seem a fruitless expenditure of energy on the part of those undertaking such work, particularly when a definite objective is sought that will provide a new method, process, or other technical achievement hitherto unknown. Endeavor to this end involves the employment of a new line of attack and mental initiative on the part of the worker, besides the building up of a structure of logical reasoning as a preliminary to formulating a plan of action. Bibliographical study will have a very limited application in such procedure. True, a general knowledge of accomplishments in the field to be investigated is expected of the research worker, but a painstaking study of all the experimental data that have been accumulated on the subject would appear more likely to thwart new avenues of approach than to encourage original thinking and stimulate invention.

For these reasons, the recent advocacy by *Nature,* of London, that bibliographical research should precede every experimental investigation, appears to be of questionable merit. And, moreover, when the publication, in discussing the thought, asserts that probably more than half the energy of British research workers is expended in repeating experiments that have already been made, the only logical inference is that either much effort is being misdirected or else a paucity of capable research talent prevails.

Existence of such conditions is possible, perhaps, but not probable. A rapid expansion in the attention directed toward one particular phase of industrial research might result in such waste of technical endeavor, but even this probably would be of such short duration that the aforesaid generalization would not be applicable. If, on the other hand, the contentions of *Nature* do reflect actual circumstances, preliminary bibliographical research may conserve some time and effort of workers, but little or no gain will thereby accrue to scientific progress.

Success in research depends on thinking ahead of what others are thinking and the seeking for an objective that others have considered beyond their reach. Bibliographies are of value in the acquisition of general information; those who are advancing the borders of scientific knowledge have little opportunity or necessity for looking backward.

Developing Domestic Supplies of Mineral Material

THE first release from the Department of Public Information of Columbia University under the new professional régime in the department of mining deals with the effect of the "Squandering of America's mineral resources as the result of a national policy of forced overproduction and unreasonable taxation . . . "; but a short and pungent comment is injected by Dr. T. T. Read against a tariff on manganese, which, he maintains, "fosters no industry and depletes our too-scanty reserves of this essential raw material."

The domestic mining industries of the United States, actual and prospective, deserve fair treatment from Columbia University. The statement that the tariff on manganese fosters no industry is not true, nor is the inference correct that the manganese industry of the United States—of infantile proportions, perhaps, but growing in technical achievement under protection—will not collapse if it be removed.

To encompass the ruin of a domestic industry dependent on research for its success, because the utilization of the ore "depletes our too-scanty reserves of an essential raw material," is to make certain that the reserves will be almost valueless in the event of emergency. However, *Engineering and Mining Journal* is in agreement with Doctor Read when he states that "The general principle involved in promoting the development of domestic supplies of mineral material has never been studied with as much thoroughness as its importance would seem to warrant."

Survey Will Disclose Status of Engineering Profession

A CORRESPONDENT WRITES bitterly of the short-sighted policy of executives who need and hire engineering help, with a background of expensive technical training and experience, and pay them what scarcely amounts to a living wage. The criticism is timely. Prevailing conditions are the outcome, in part at least, of a lack of professional solidarity, an absence of any equivalent to the trade union. The situation is complicated by a deplorable absence of reliable data. Many engineers are ashamed to disclose what they are earning, lest the amount be taken as indicative of their worth or suggestive of incapacity.

In an attempt to throw light on a vexing problem, and incidentally to raise the status of the engineering profession in the United States, the American Engineering Council has appointed a committee to collect, tabulate, analyze, and disseminate information on the earnings of engineers in the several branches of the profession.

Engineering and Mining Journal notes with interest that Mr. H. C. Morris, an alumnus of Massachusetts Institute of Technology, and formerly connected in a managerial and consulting capacity with various mining interests in the United States, Canada, and Mexico, has been appointed chairman of the committee. The outcome of the survey will be awaited with interest.

THE COPPER DEPOSITS OF

The Roan Antelope outcrop in 1925, looking Southeast. This illustrates the natural clearing along the copper bearing outcrop.

RECENT DEVELOPMENTS in the copper field near N'Dola, Northern Rhodesia, have been of such importance as to bring this district to the attention of the entire world. Considerable work has been done on the deposits by engineers and geologists of high standing, and some of their findings and opinions have been made public. But these, so far, have been fragmentary, and it seems opportune at this time to present a résumé of the geology, ore deposits, and possibilities of one of the important areas of the district.

We have been concerned chiefly with the development of the N'Kana Concession, and these articles will deal principally with the ore deposits and geology of that area. Mention will be made of the geology of the surrounding country and near-by deposits, but they will be discussed in the light of information gained during work on the N'Kana Concession, not in detail.

An attempt will be made adequately to acknowledge all sources of information, but this is not always possible. Therefore, in presenting this résumé, we desire to acknowledge our indebtedness to all the men who have contributed to the present knowledge of the country. Dr. J. W. Lunn, of the Anglo-Belgian Boundary Commission, has furnished much information on the correlation of the Rhodesian rocks with those of the Belgian Congo. The late Mr. T. F. Andrews did much valuable pioneer work in the geological mapping of the Concession. And finally, we wish to express our gratitude to the directors and management of the Roan Antelope Copper Mines, Ltd., and Rhodesian Selection Trust, Ltd., whose co-operation has made the work possible, and by whose permission it is published.

The N'Dola copper district is on a plateau which rises from an elevation of about 2,000 ft. on the Zambezi River, to somewhat over 4,000 ft. on the Rhodesian-Congo border where the frontier follows the divide between the Congo and Zambezi River basins. N'Dola and N'Kana concessions are on the northern and higher part of this plateau, near the southern Katanga frontier. The elevation of N'Dola is 4,087 ft. and the greatest difference in elevation on the N'Kana Concession is not much over 500 ft.

For the most part the concession is a gently undulating plain, broken at rare intervals by gorges or smaller ravines and by ridges and kopjes of resistant rock, which rise abruptly for several hundred feet above the general level of the ground. The gorges and ravines are almost confined to the Kafue River and the smaller streams near their junction with it. Kopjes are scattered irregularly over the entire area, but pronounced ridges are found principally along the watershed between the Congo and Zambezi drainage systems. What may be termed the uplands of the area—the broad gently sloping lands lying between the streams—are the remnants of an ancient plain, probably a peneplain. The occasional kopjes which are found scattered over the area appear to be monadnocks, and in most cases have no apparent connection with the present cycle of erosion.

The ridge which forms the Congo-Zambezi watershed contains the highest points of the concession. Locally, as between Mokambo and Kipula, this watershed is definitely attributable to the presence of long outcrops of the resistant quartzites of the Roan Series. At other places—for example, just east of Kilenko and in the re-entrant of the frontier which contains Sankania—may be seen an attempt to follow this same formation. The resulting position of the ridge appears to be a compromise between the conflicting forces of streams already established and strengthened by a renewal of erosional activity and the resistant structural features of the folded quartzites.

From the frontier the ground slopes gently toward the Kafue River, and as gently upward again to the west. In this broad shallow valley the drainage is east and west through similar but smaller valleys into the master stream. Near the heads of these streams the valleys are flat and swampy, forming large open spaces called dambos. Near the Kafue, however, these same streams have entrenched their old meanders, deepened their channels, and in some cases cut steep ravines. The Kafue itself, at least in the rainy season, is actively degrading over its entire course within the concession. It flows in part through winding and steep-sided gorges, and in many places the remnants of its old gravel bed may be seen well above the present level of the water. Along the flatter parts of its course are the remnants of natural levees flanked by old flood plains, but there is no indication that the water has arisen high enough for a long time to inundate these.

The general pattern of the drainage in the area is largely independent of

NORTHERN RHODESIA

Geology, Orebodies, Potentialities: with special reference to the N'Kana Concession

By ANTON GRAY *and* R. J. PARKER

Chief Geologist *Manager*

Rhodesian Selection Trust, Ltd.

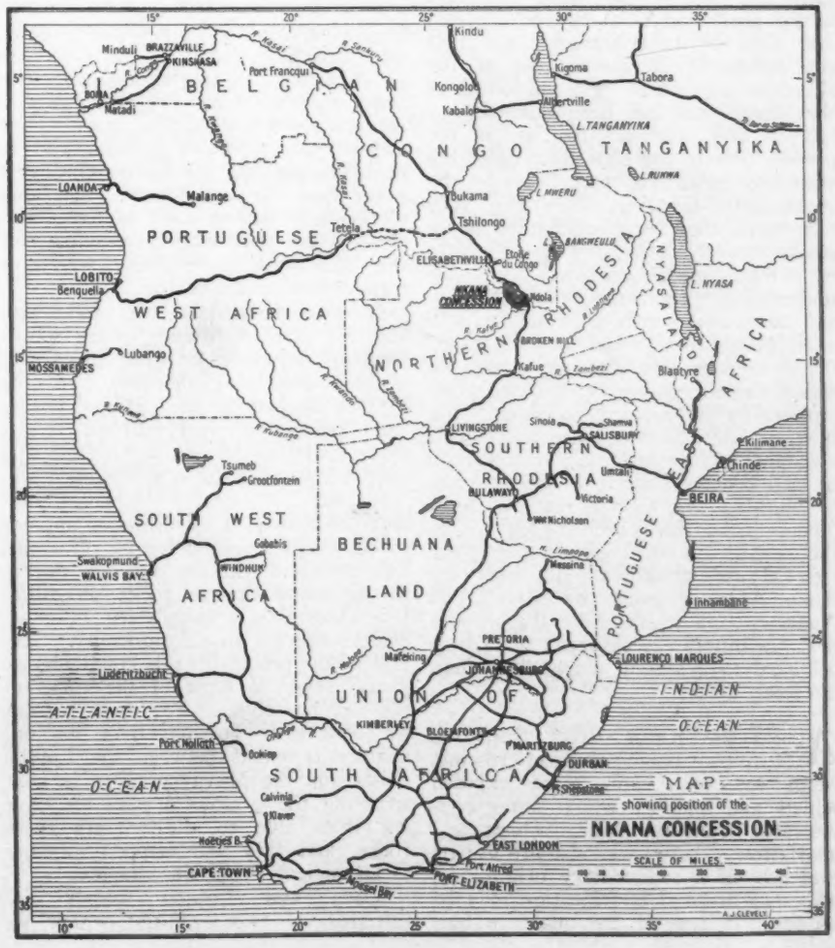
underlying rock structures. The Kafue, which is a fairly large stream, turns aside at some places to follow the strikes of resistant rocks, but on the whole it appears to be following and entrenching the course upon which it was meandering on the ancient plain. Smaller streams flow more or less directly to the Kafue, except—usually on the younger sediments—where they follow for short distances along the strike of the beds or along contacts. The streams east of the Kafue in particular, in their upper parts, have a tendency to follow the structure of the rocks before they finally break across the sediments on to the older schists and granites.

In this connection it is interesting to note that the contact between the beds of the system of the Katanga and the granites and schists, which runs from Mufulira to N'Dola, marks a well-defined line of springs. Much of the drainage on the sediments appears to be subterranean. This is particularly well shown in the Misishi, near N'Dola, which rises from the sediments to flow for a short distance over granites, only to disappear entirely, except during the rainy season, when it again comes into contact with the sediments. This same tendency is to be observed to some extent in the streams west of the Kafue, and the sedimentaries of the system of Katanga are the great water-bearing rocks of the area.

IT WOULD APPEAR, then, that this drainage system is largely superimposed. Its general plan is that which was assumed by the streams meandering over an old surface, very near base level. Recently there has been a rejuvenation, and a new cycle of erosion has commenced. This has not continued long enough to destroy the features of the old plain, but the valleys are being deepened, the streams entrenched. The topography is in a very youthful stage of development.

The soil is usually very deep, and with the exception of swamps and dambos, the entire area is covered with a dense growth of trees. Viewed from some high point it appears as a gently rolling sea of green bush, through which may be seen to penetrate abruptly occasional small masses of rock.

ALL the mineralization of economic value so far found in this district occurs in a series of sandstones, shales, and dolomites, the extent of which in Central Africa is at present unknown. These rocks have at various times and places been called the Congo Border, Bwana M'Kubwa, N'Kana, N'Changa, and Roan series. The upper limit of the series, under these various names, has seldom been defined. We have called these rocks the Roan Series since the time they were first investigated at the Roan Antelope mines. The following geologic description will show the limits we have placed on the series and its relation to both older and younger rocks.



The rocks of this area may roughly be divided into four groups:

(1) Intrusive rocks, acid and basic, which are younger than the system of the Katanga; (2) younger sedimentaries belonging to the system of the Katanga; (3) granites intrusive into the older schists; (4) ancient schists and gneisses, forming what may be termed a basement complex.

The accompanying geologic column shows the relative ages of these rocks, so far as they are known now. This column is necessarily generalized, and the correlation is more or less tentative. Exposures of these rocks are not numerous, and much of our knowledge of them has been gained by shallow mining work and drilling. The possible correlation with rocks outside the concession is based, in part, on observation of the rocks of the system of the Katanga on the Congo side of the frontier; in part on the written description of these rocks; and in part on information kindly furnished by Dr. J. W. Lunn, geologist to the British Section of the Anglo-Belgian Boundary Commission, who has had an opportunity to observe these rocks over an area much greater than the very limited confines of the N'Kana concession.

THE Pre-Roan schists and gneisses are exposed within the N'Kana Concession, principally in a zone 10 to 15 miles wide, following more or less the course of the Kafue River. They form the core of the major structure of the area, and it is only on the east and west of these ancient rocks that the sediments of the system of the Katanga are found. The structure of the schists has not been studied, nor has it been possible for us at the present time to correlate them definitely with any system of rocks outside the concession. Certainly they are very old rocks, their original nature being almost entirely obliterated by the effects of extreme metamorphism. Some are undoubtedly sediments, being now quartzites and quartz-mica schists. In some places these rocks may be traced for a considerable distance along the strike, the correlation being based principally on lithologic characters, but in very few places is there a sufficient remnant of the original stratification to enable determination of the attitude, or the top and bottom of the beds. These rocks have been called by us the Muva schists, because they were first studied at Muva Hill, near the Roan Antelope mine, by Mr. T. F. Andrews, and it was here that it was first definitely recognized that they belonged to a system much older than the Roan Series.

ALONG the Kafue River from the Mufulira-Chambishi road-crossing, south for some miles, are exposed schists and gneisses which differ considerably from the Muva schists and quartzites. These rocks also are in part evidently of a sedimentary origin, and traces of original stratification may be found in a few of the quartzite outcrops, but most of the rocks exposed in this particular stretch of the river are so contorted, so thoroughly recrystallized, that we have not been able to recognize original characteristics. They are in part injection gneisses and in part fine-grained schists containing a great deal of amphibole. Their distortion and folding seem to have been more severe than is evident in most of the Muva schists. These we have termed the Lufubu schists.

Near the Kinandola Falls, and traceable for a short distance to the southeast, are exposures of what appears to be an ancient conglomerate. The rock has the appearance of a gneiss, but in the thoroughly recrystallized schist matrix are to be found pebbles, and even a few boulders, now flattened and elongated but clearly showing their original nature. This formation appears to be several hundred feet in thickness, and combined with the differing degree of distortion of the rocks on either side, and their dissimilarity in character, suggests an unconformity. Several of the pebbles in this conglomerate gneiss resemble some of the rocks of the Lufubu schists. For these reasons we believe it possible than an unconformity exists between the Lufubu chists and the Muva system. In constructing the geological plan we have not been able to differentiate these rocks, and they are mapped together as an ancient Pre-Roan complex.

Muva and Lufubu schists are intruded by two granites, which we have called the older gray granite and the Muliashi granite gneiss. These rocks may be part of the same intrusive mass, but as neither has been observed to grade into the other, and as their characteristics are so entirely different, they have been considered as two separate rocks. Both are younger than the Muva schists, but older than the system of the Katanga, and both form a part of the ancient surface upon which the system of the Katanga was laid down, as is evidenced by fragments and boulders in the basal conglomerates of the latter system. The Muliashi granite-gneiss is a very coarse-grained biotite-granite, characterized in large part by pink orthoclase crystals up to an inch or more in length. Although the rock in many places appears fresh and undisturbed, it is in large part so crushed and schisted as to resemble an augen-gneiss. In the N'Kana Concession this rock is exposed only in the northwest along the banks of the Muliashi River.

The older gray granite is exposed at various places over the concession. In the hand specimen it appears to be a fine-grained normal biotite-granite, usually very gneissic in texture. This gneissic texture is undoubtedly the result of crushing, and is probably due, as is also the crushing of the Muliashi granite, to the movements which caused much of the metamorphism of the Muva-Lufubu schists.

OVERLYING the ancient Lufubu-Muva schists, and separated from them by a great unconformity, are found the sediments of the system of the Katanga. The basal formation of the Roan Series, the lowest rocks of the system of the Katanga, is a conglomerate of varying thickness and character. In places this conglomerate is entirely missing. In others it becomes 300 to 500 ft. thick, and occasionally more, and these changes in thickness take place over exceedingly short distances along the strike. This basal conglomerate of the Roan Series is variable in composition as well as thickness. In one exposure at Kalulushi the boulders are fairly uniform in size, averaging probably six to nine inches in diameter. They are here composed almost entirely of the underlying Muva sandstones, and this underlying rock is well exposed over a long strike in this particular vicinity. The boulders are fairly well rounded, and most of them are more or less elongated. The matrix is a coarse feldspathic grit, somewhat schistose, and the boulders comprise probably 75 per cent or more of the rock. Here the basal contact of the conglomerate has not been observed, but the formation is probably more than 500 ft. in thickness and grades with no abrupt change into the over-grits and arkoses of the Roan Series. The boulders become smaller and fewer, until finally they exist only in the form of lenses in the grit.

This conglomerate or boulder bed is well exposed at one other place on the concession. Where the Mutundu

Tentative Geologic Column
N'Kana Concession

I—Acid and Basic Intrusives:
- 1. Gabbro and diabase sills
- 2. Younger gray granite

II—System of the Katanga:
- 1. Purple Quartzite Series
  Quartzites with few shales 7,000 ft. +
- 2. Mutondo Series
  Sandy shales 7,000 ft.—8,000 ft.
  Dolomitic shales
  Dolomite
  Fluvio-glacial sediments, including conglomerate
- 3. Christmas Series 2,000 ft.
  Quartzites and shales
- 4. Roan Series 3,000 ft.—4,000 ft.
  Dolomites, shales, sandstones, quartzites, arkose, and conglomerate
  Great unconformity

III—Granitic Intrusives:
- Muliashi porphyritic granite and gneiss
- Older gray granite

IV—"Basement" schists:
- 1. Muva schists
  Quartz-mica schists, quartzites
  Unconformity (?)
- 2. Lufubu schists
  Schists, injection gneisses, granite gneiss

River, east of the Kafue, passes from the quartzites of the Roan Series on to the ancient schists, it has carved out a deep ravine. At this point the rock directly underlying the conglomerate in the older gray granite, and the boulders of the conglomerate, are composed almost entirely of this rock. Here also the boulders are fairly uniform in size, and the conglomerate is similar to that at Kalulushi, with the exception of the difference in composition of the boulders. The thickness here is not over 75 ft., probably less, and the same gradual change from coarse conglomerate to the overlying grits and sandstones may be noted.

In most of the exposures of the basal conglomerate of the Roan Series the rock is not so distinctly a boulder bed, but rather a more or less conglomeratic, irregularly textured grit. The pebbles and boulders, though generally well rounded, are variable in size, and usually make up less than 50 per cent of the rock. They are generally fragments of the older schists, quartz, granite, a few pebbles of limestone which has not been found in place in the concession, and one or two fragments of basic igneous rock. The matrix is always more or less feldspathic and usually contains a considerable amount of white mica, as well as thin layers of shale. These thin shale layers or lenses are considerably broken up, and fragments of them are found scattered through the rock for several feet above. They give evidence of the varying conditions of deposition of this conglomerate.

Overlying this basal conglomerate, or boulder bed, are three to four thousand feet of sediments, near the base of which have been found all the copper deposits of economic value known in the concession. These rocks, since the time they were first studied by us in connection with prospecting work at the Roan Antelope mine, we have termed the Roan Series.

For convenience, the series may be divided into two groups, the upper and lower Roan. The upper group rarely outcrops and the nature of the beds is not well known. The lower, containing much quartzite and grit, and well exposed by drilling and mining operations, has been studied in some detail. Nearly all this study, however, has so far been megascopic, except for several specimens of ore which have been studied microscopically. These will be mentioned in the discussion of ore deposits.

The basal beds of the Roan, aside from the boulder bed, are arkoses, grits, and feldspathic quartzites, with a few layers of more or less well-bedded sandy shales. The arkoses are composed principally of quartz grains, usually angular and varying in size from 3 mm. down. Fragments of feldspar occur in varying proportion, angular in shape, usually white but often pink. They are rarely over 3 to 4 mm. in length, but in some very coarse beds they are considerably larger, and are then usually of the pink variety. Mica occurs irregularly scattered through the rock, sometimes in large crystals, but more often in small plates. It is usually of a white variety, but biotite is found at places, particularly in the lower beds.

Accessory minerals include magnetite, often arranged along bedding planes; hematite as a disseminated red powder and in casts after pyrite; and numerous small dark mineral grains, impossible of determination without the aid of a microscope. The cement of this rock is usually a fine "dirty" or shaly material, the only constituent of which may commonly be recognized as white mica, in very fine plates. Rarely the rock has been altered to a quartzite and cemented by silica.

The feldspathic quartzites differ from the grits in that they are fine grained and contain a smaller percentage of feldspar. The cement is usually silica, and although often stained with limonite and containing magnetite, they are cleaner rocks. In texture these rocks are variable. Fine and coarse beds alternate in varying proportions, and many of them are lens-shaped. Somewhat fine and even bedding will give way abruptly to a bed marked by coarse cross-bedding or no bedding at all. This cross-bedding slopes in all directions and is sometimes exceedingly complex. Pebbly or conglomerate layers of varying thickness occur at many places, as do also layers of fine shaly material, usually only a few inches thick, and which are often found to be cracked and broken.

At Mufulira, where the best sections of the lower Roan have been exposed, these beds have a thickness of about 1,500 ft. About 600 to 800 ft. above the base of the series the shaly beds become thicker, and much of the quartzite is finer and argillaceous. Lenses of dolomite, reaching a thickness of 20 ft., appear at several horizons. At Bwana M'Kubwa this horizon is very dolomitic, three or four beds of some thickness occurring. The deepest boreholes at Mufulira, started at about 1,500 ft. from the basal conglomerate, have penetrated beds in which fine shaly sands occur in about equal amounts with the feldspathic quartzites, and interbedded with them.

In the western part of the concession the beds of the lower Roan are somewhat different. Between the arkoses and grits several persistent beds of well-banded sandy shales are found, and much of this is very schistose. There are also thick beds of interbanded schist and coarse feldspathic sandstone, the individual layers of which have been found to vary from a few inches to several feet in thickness.

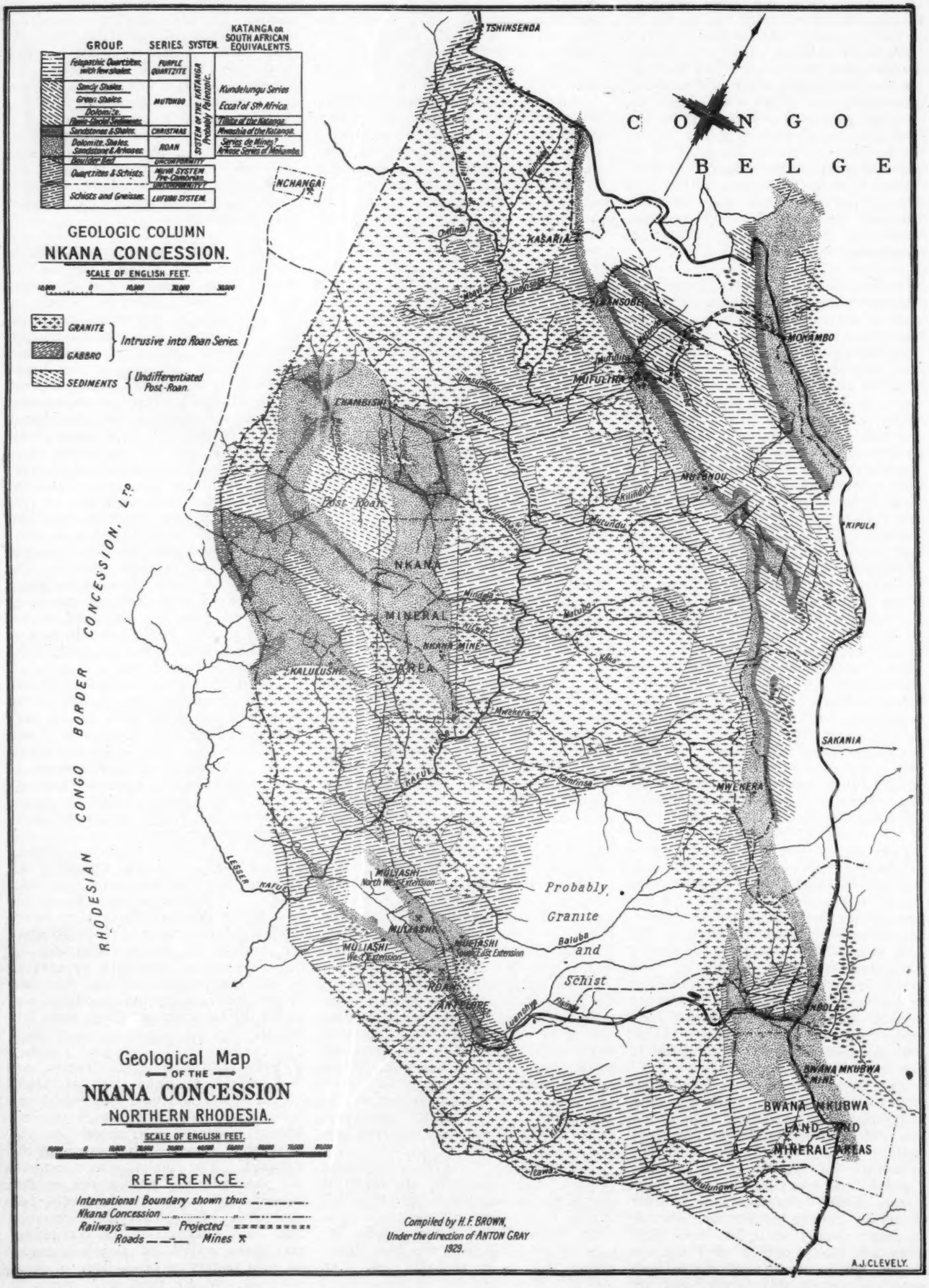
The orebodies of the Roan Antelope, N'Kana, and Chambishi are found in one of the banded shales, and this rock varies from a very siliceous to a dolomitic variety. Its distance from the base of the series has not been determined, but it is probably less than 500 ft. Metamorphism of these rocks has sometimes, but not frequently, been severe enough to disguise their original nature. The dolomites have undergone more metamorphic alteration than the other rocks. Usually a white or gray, thoroughly recrystallized rock, it is sometimes found as quartzose talc schist, and sometimes so thoroughly silicified as to resemble a brown chert. The sandstones are often thoroughly recrystallized. In the argillaceous beds schistosity has developed at places, and even where it has not there is usually considerable white mica, which appears to be secondary.

Only rarely do the rocks of the upper Roan outcrop, and for this reason it is suspected that they contain very little quartzite. Most of the pits sunk to determine the structure of these beds have encountered shales, argillaceous sands, and abundant talc schists. At the Lufua prospect, in the Congo near the head of the Mwekera stream, a considerable thickness of dolomite has been found, and this is probably in the upper Roan. The highest bed of the series is a sandstone, angular grained and of irregular texture. In the lower Roan the beds must have been deposited in very shallow waters and under varying conditions. The source of the coarse materials was evidently the older granites and Muva and Lufubu schists. The nature of the body of water in which the sediments were deposited cannot be determined from the study of so restricted an area, but it must, in time at least, have been extensive, probably a large lake or epeiric sea.

The conglomerate and grits, of such variable thickness and texture, must have been laid down on or near a very irregular shore line and near a terrain of considerable relief. Quieter conditions alternated abruptly with times of flood, and probably the variable currents of the rivers, combined with the irregular shore line, caused strong and shifting off-shore currents.

When the water had become deeper, and the relief of the land surface lower, finer sediments, better sorted, were deposited. Though it is almost impossible to correlate definitely the various lower beds in different parts of the concession, the horizon at which limestones or dolomite become dominant appears to be fairly consistent. From this time deeper water or quieter conditions prevailed till the uppermost beds were laid down.

Overlying the Roan Series are several thousand feet of interbedded shales and quartzites which we have termed the Christmas Series, and which evidently correspond to the M'Washia Series of the system of the Katanga. The shales where exposed are predominantly gray, more or less banded, and in part schistose. The quartzites, which form more outcrops than any sediment in the concession, are characterized by rounded grains set in a matrix of much finer siliceous material. Where thoroughly cemented


GROUP. SERIES. SYSTEM. KATANGA OR SOUTH AFRICAN EQUIVALENTS.
Felspathic Quartzites, with few shales. PURPLE QUARTZITE SYSTEM OF THE KATANGA Probably Palæozoic. Kundelungu Series Ecca of S. Africa.
Sandy Shales. Green Shales. Dolomite. Flaggy Calcic Sediments. MUTONDO Tillite of the Katanga.
Sandstones & Shales. CHRISTMAS Mwashia of the Katanga.
Dolomite, Shales, Sandstone & Arkoses. ROAN Series de Mines? Arkose Series of Mafumbo.
Boulder Bed. UNCONFORMITY
Quartzites & Schists. MUVA SYSTEM Pre-Cambrian.
UNCONFORMITY
Schists and Gneisses. LUFUBU SYSTEM.
GEOLOGIC COLUMN
NKANA CONCESSION.
SCALE OF ENGLISH FEET.
GRANITE
GABBRO
Intrusive into Roan Series.
SEDIMENTS
Undifferentiated Post-Roan.
Geological Map
OF THE
NKANA CONCESSION
NORTHERN RHODESIA.
SCALE OF ENGLISH FEET.
REFERENCE.
International Boundary shown thus
Nkana Concession
Railways
Projected
Roads
Mines
Compiled by H.F. BROWN, Under the direction of ANTON GRAY 1929.
A.J. CLEVELY.
RHODESIAN CONGO BORDER CONCESSION, LTD
C O N G O B E L G E
TSHINSENDA
NCHANGA
KASARIA
MANSOBE
MOKAMBO
MUFULIRA
CHAMBISHI
MUFULIRA
KIPUILA
NKANA
MINERAL
AREA
NKANA MINE
KALULUSHI
SAKANIA
MWENERA
MULIASHI North West Extension
MULIASHI
MULIASHI West Extension
MULIASHI South East Extension
Probably Granite and Schist
ROAN ANTELOPE
NDOLA
BWANA MKUBWA MINE
BWANA MKUBWA LAND AND MINERAL AREAS
Post-Roan
Probably Granite and Schist

by silica, this rock has a very characteristic oölitic appearance, and is one of the very few good horizon markers of the concession. In texture it grades from very fine to very coarse sand. Much of it is nearly pure, but some of the beds contain considerable feldspar, and some are characterized by the presence of a great deal of pyrite or marcasite.

PROBABLY most of the Christmas Series is composed of shales, but there are three and possibly more of the quartzite members which vary from 50 to 100 ft. in thickness. This series apparently lies conformable upon the Roan, but at several places near Mufulira, where the contact between the two series has been observed, there is a conglomerate 50 ft. thick or more at the base of the Christmas, and this conglomerate is composed of small fragments and pebbles of sandstone and shales, which resemble those of the Roan Series, contained in a sandy matrix. It is the evidence of this conglomerate which leads us to believe that there is at least local disconformity between these sediments and those of the Roan, and it is for this reason that we have separated the Christmas Series from the Roan Series.

Overlying the Christmas Series, and apparently conformable with it, there is at least 15,000 ft. of sediments, corresponding in part to the Kundelungu Series of the Katanga. The lower 7,000 to 8,000 ft. of these we have called the Mutondo Series. Of this series, the lowest formation in the N'Kana Concession is made up of interbedded shales, sands, and conglomerates, which we believe to be of fluvio-glacial origin. The total thickness of these rocks is not over 500 ft.

THE lowest bed of the formation is a very coarse conglomerate. Where found under the water of several streams in the area, it appears to be composed of subangular boulders and pebbles, a few of which are striated. These vary greatly in size, some being over 1 ft. in diameter, some being hardly large enough to be called pebbles. They are made up principally of quartzite, quartz, some limestone, granite, fine-grained basic rock, and large individual crystals of orthoclase, all contained in a very fine-grained matrix. The thickness of this lower conglomerate is not known, but above it and separated by beds of fine-grained non-conglomeratic materials there are several—perhaps six or seven —beds of conglomerate of varying thickness. These for the most part contain smaller pebbles, mostly subangular, scattered irregularly through a fine-grained shaly matrix. The pebbles and boulders rarely touch one another, and in this part of the formation no striations have been found upon them. Several thin beds of arkose have also been identified as occurring in the formation.

These beds of conglomerate consist of what is known as the Tillite of the Katanga. This rock was first identified by Mr. J. W. Lunn, of the Anglo-Belgian Boundary Commission. However, if this were a true Tillite it would not be expected that the beds should lie upon the Christmas with apparent conformity. That they do is an indication that they are not an ancient moraine, but rather a fluvial deposit, laid down upon the rocks of the Christmas Series before that series had been seriously disturbed. The glacial origin of some of the materials is indicated by the angular striated boulders, and by the similarity of the more or less conglomeratic layers to the fluvio-glacial sediments found at the base of the Ecca Series.

Above this lowest formation of the Kundelungu, or so called Tillite of the Katanga, is found, in varying thickness, a thoroughly recrystallized blue-gray dolomite. The contact between these two rocks has not been observed, and in some places the dolomite appears to be missing, in others reaching a maximum thickness of over 1,000 ft. This rock has to a large extent been so brecciated and silicified as to be unrecognizable if it were not for the occasional outcrops of unaltered limestone in the horizon. Near the top this dolomite becomes argillaceous and passes gradually into the overlying dolomitic shales, of which there are perhaps 4,000 or 5,000 ft. These shales in turn gradually lose their dolomitic character and become sandy, grading upward into the coarse bluish impure sandstones and quartzites which we have termed the Purple Quartzite Series.

THE quartzites of the Purple Quartzite Series are exposed in the concession for a distance of perhaps 7,000 ft. They form the youngest sediments in the area, with the exception of the recent alluvial deposits. These rocks are for the most part distinctive. They grade from very fine to coarse in texture, and in part are so feldspathic as to resemble an arkose, but all are similar in that they are characterized by the purple color for which we have named them. Interbedded with these quartzites are a few beds of shale.

These sediments—the Roan Series, Christmas Series, rocks of the Kundelungu Series, fluvio-glacial conglomerate, dolomites, shales, and Purple Quartzites —comprise the system of the Katanga, as exposed in the N'Kana Concession. No doubt the interbedded conglomerates, shales, and arkoses at the base of the Kundelungu corresponds to the Tillite of the Katanga. The underlying Christmas Series is similar to the M'Washia Series as described by the geologists of the Congo. Inasmuch, then, as the Serie de Mines of the Katanga underlies directly the M'Washia Series, and in the N'Kana Concession the Roan Series forms the base of the system, we have concluded that the Upper Roan Series in this area is probably the equivalent of the Serie de Mines. If this be true, all the important copper deposits known in this district, including the Katanga, are contained in the rocks which we have called the Roan Series.

RESPECTING younger intrusives, two granites exposed in this area appear to be younger than the system of the Katanga. One we have termed the younger gray granite, which outcrops over considerable areas in the belt of older schists lying between the areas of sediments. Detailed work, pitting and drilling, has shown that this rock intrudes the lower beds of the Roan at some places, but has never penetrated them to any great distance. This younger granite is a medium-grained gray biotite-granite, occasionally showing a very distinct gneissic texture. At some places where this is found the feldspar appears crushed and broken, and the structure is evidently produced by extreme pressure. Although predominently gray in color, this rock is sometimes characterized by pink feldspars, as in the outcrops near Mufulira. At other places, as exposed on the Kafue River, biotite is replaced by muscovite, and the rock also contains much tourmaline, resulting in an apparently extremely acid white tourmaline-muscovite-granite. These pink and tourmaline-bearing phases are the exception, however. In most places the rock is the normal gray granite, which so closely resembles the older gray granite that in isolated outcrops it is often impossible to tell which rock is represented. Near the points where this rock has penetrated the lower beds of the Roan, the latter contain many quartz veins, and it is near these points also that the mineralization is found. This granite is believed to have been the source of the copper which forms the important deposits in the area.

N'CHANGA red granite, which appears at N'Changa mine to intrude the lower beds of the Roan Series (Louis Reber, geological map of N'Changa mine), is found in the concession only along the western border. Its relation to the younger gray granite is not known. It bears no resemblance to the latter, however, being a very coarse almost porphyritic rock characterized by large, pink microcline crystals. For this reason it has been mapped separately, although it is possibly a phase of the same intrusive.

West of the Kafue River and at Muliashi are found many outcrops of very basic igneous rock. In part these resemble a gabbro; in part they are a diabase. Most of the outcrops are isolated, and the structure of the rock has not been determined, but it appears to follow, more or less definitely, certain horizons of the Roan Series. At one place, Kalulushi, a drill has penetrated diabase and passed through it into the sandstones of the Roan. We are inclined to believe that most of this basic rock has been intruded into the Roan Series in the form of sills or lopoliths. Its age with relation to the granite has not been determined. From its freshly crystalline texture it would appear that it has not undergone any considerable deformation and was therefore intruded after the folding of the sediments.

(To be continued)

INDUSTRIAL MUSEUM

DR. OSKAR VON MILLER in 1903 sponsored a plan for a permanent German techno-industrial exhibit. The scheme reached fruition in 1925, when a unique museum was opened on an island in the River Isar at Munich. . . . Germany acted as a unit in bringing the plan to a successful conclusion. Neither provincial preferences, personal ambitions nor political influences marred the outcome. To the genius of Dr. von Miller the world is in debt. The city of Munich gave the site and contributed to the cost. . Both the German and Bavarian governments and German industry made large donations in money and material.

The administration of the Museum is under the presidency of the Chancellor, the Minister of the Interior, the Bavarian Minister-President, and the Bavarian Minister of Education. An advisory council and a general committee represent German science and German industry. The Deutsche Museum at Munich is an example, which commands respect, of the single purpose of the various governmental, industrial, and academic units comprising the German people.

A blacksmith's forge, as seen in the Black Forest about 1800. The hammer is hydraulically operated.

Fosters Interest in Mining and Metallurgy

Coal miners at work in a typical German narrow-seam deposit

A room underground that has been fashioned and lined to show how rock salt is mined in Continental Europe

The figures are extraordinarily lifelike. A visitor to the Deutsche Museum who is ambitious enough to make at least a cursory examination of the contents of all the three hundred rooms and corridors must walk a total of nine miles. Confusion and waste motion are prevented by adequate arrow signs, with opportunity at intervals for those who have seen enough for one visit to take a short cut to the main corridor.

COMMENT AND CRITICISM

The Follsain Process for Low-Grade Blende

European Metallurgists Effect Intensive Oxidation and Volatilization in Rotary Furnace

To the Editor of "E.&M.J.":

A large amount of experimental work is now proceeding in the attempt to evolve a cheap and satisfactory zinc-refining process to supersede distillation in regions where the unavailability of cheap power prevents use of electrolytic treatment.

In the last few months the Coley process has attained considerable publicity from flotation on the London market of the Zinc Manufacturing Company, Ltd., with a capital of £1,000,000. The company proposes to operate this process in Great Britain, France, Spain, Portugal, and the colonies of the last three countries. The Coley process is claimed to be capable of extracting zinc from practically every known type of ore, as well as from complex ores and residues. Its critics, however, aver that it will be found to be strictly limited to the treatment of calamines. It must be observed that it is for the treatment of this ore only that Zinc Manufacturing is erecting plants in England and North Africa. The future will determine how far the Coley process will be applicable to the treatment of sulphide ores on a commercial scale.

The Waelz process is operating in several countries, but, according to my information, it is confined to the production of zinc oxide. It has its good points in its own sphere. Since its abandonment by the British-Australian group, the Ashcroft process has been given the cold shoulder by other zinc interests, notwithstanding the inventor's claims that the difficulty that caused the investigators to abandon the process has now been surmounted.

Recently I have inspected what promises to be the best of all the new processes—the Follsain process, named in honor of its inventors, MM. Folliet and Sainderichin. M. Folliet has been a leader among European zinc metallurgists for twenty years. The novel feature of the process, essentially a volatilization treatment, is the use of cheaply produced hot air, which maintains a constant temperature of 700 to 750 deg. C., which in turn promotes an intensive combustion of carbon. A temperature of over 2,000 deg. C. is developed, with an instantaneous and high production of carbon monoxide.

A mixture of ore and reducing coal is brought in contact with a jet of hot air near the discharge end of a rotary furnace. Being already heated during their descent along the furnace, the metallic elements in the charge are subject to intensive oxidation and volatilization as they come in contact with the jet of air, at the high temperature resulting from the oxidation of carbon. As this high temperature is developed only near the discharge, the slag comes out in clean, granulated form. Any pasty scorification of the slags is avoided.

Lead and silver in the ore is oxidized and volatilized along with the zinc. The product, which is collected by a novel baghouse method, is eminently suitable for treatment in an electrolytic plant. The zinc oxide recovered from the baghouse contains 60 to 80 per cent zinc, depending on the quantity of lead in the ore. Hot air is produced by the Philipon system of continuous superheaters. The remarkable development that has taken place during the last nine to twelve months in the method of utilizing continuous superheaters at very high temperatures was really instrumental in the discovery of this new method of treating low-grade zinc ores.

Any type of rotary furnace lined with the usual refractories can be employed. There is no heating other than that supplied by introduction of the hot-air jet. The crude ore must merely be ground to the size of a pea, and fed into the furnace with the correct proportion of coal. The cheapness and simplicity of the Follsain process, and the small expense involved in constructing a plant of commercial size, make a strong appeal. A recovery of 90 per cent or more of the zinc, lead, and silver content of the ore is claimed by the inventors. They are confident that cost of treatment will not exceed 10s. per ton of ore.

I have not attempted to describe the process in the detail given in the patent specifications. Applications for patents have been filed in all the principal countries of the world. The United States serial application number is 366,522, filed on May 27, 1929; the Canadian number is 351,516, dated June 6, 1929; and the British application is numbered 16,376, and is dated May 28, 1929.

The experimental plant is situated near Compiègne, France. Its capacity is five tons per 24 hours. It has been inspected within the last month by representatives of a Silesian and a French zinc company, with the result that in both cases trial units will be erected. Should the inventors' claims be substantiated on a commercial scale, a new and most interesting field for the treatment of ordinary and low-grade zinc and zinc-lead ore is opened up. If the process succeeds in eliminating washing and flotation plants, or flotation only, it will have wide application. For example, from the Bawdwin ore of Burma Corporation the flotation concentrate, containing 50 per cent zinc, is shipped to Europe for treatment, most of the profit disappearing in heavy transportation and reduction charges. If the new treatment be proved applicable to Bawdwin ore, so that electrolytic zinc, or rich oxide concentrate, could be shipped, the increase in profits would be great. No doubt Mining Trust will take an early opportunity to demonstrate the value of the new discovery for handling Mount Isa and Villemagne ores.

My imagination has unquestionably been captured by the Follsain process. It is the most interesting discovery that has come under my notice since the development of selective flotation for handling low-grade mixed ores.

London, England. A. J. M. SHARPE.
International Metal Service.

London observer believes Follsain process to be the best of several new zinc-refining processes intended to supersede distillation in regions where the unavailability of cheap power prevents use of electrolytic treatment. . . . A five-ton experimental plant is now in operation near Compiégne, France, and two additional trial units will be erected.

Early History of the Snowflake

To the Editor of "E.&M.J.":

At times one feels like unburdening to the world at large the little inside stories pertaining to properties and prospects which suddenly attract public attention. I am sending the following little note in connection with the Snowflake mine, of British Columbia, which may or may not prove of interest to readers:

In the fall of 1926 I made the acquaintance of two gentlemen in the lumber business, but not doing so well, you might say. They had a large sample of galena ore on display in their office, which was not receiving any particular attention, though they were optimistic enough.

I made a deal with them for a one-third interest in the property for $36,000, to be paid over four years, I believe. This money was to go to a prospector in the village of Albert Canyon, B. C. I put up a little money, made an examination of the property in November, 1926, and saw sufficient to convince me of the merit of the claims. I then went to Seattle and endeavored to enlist financial assistance for the additional amount necessary, and would perhaps have succeeded but for the advice of a bootlegger to my client.

I have made money out of mines worth less, but I call attention to the Snowflake incident because, in mining, for reasons unknown to me, the majority of people feel that always they are being led into a sucker deal, though anything in mining I ever undertook to find money for proved a winner. I am glad to see that this property is turning out better even than I hoped.

New York, N. Y. J. E. HAIGHT.

Jack Hammers, Sows, and Something to Shoot At

To the Editor of "E.&M.J.":

I recently ran across the following advertisement in the *Wilkes-Barre Record* and I thought it might interest some of your readers:

FOR SALE—One jack hammer, 50 feet hose, 3 blow drills, $55. One female pig, 130 pounds, $16. 12 Mulberry St., Swoyerville.

I have seen a "sow" used in sharpening drill steel by hand, but never a real live one. Some old-time blacksmiths will blush for shame that they did not raise them instead of killing a couple of helpers trying to forge one out.

Another clipping will interest the metal miner, as most of the material mentioned is from metal or non-metallic mines; but the orator did not state how many more miles of trolley wire the anthracite industry uses than the average traction company requires. But it is something for the metal miner to shoot at!

"An excellent address on the bigness of the anthracite industry and its great contribution to the progress of America was given before Rotary Club at luncheon meeting yesterday by William H. Bond, field representative of Anthracite Co-operative Association.

"The speaker said in part:

"'Let me give you a picture of this anthracite industry. You have heard of the wonderful flood control work the United States government is doing on the Mississippi River. The government is going to spend more than $300,000,000 to keep that mighty river from overflowing its banks. That, gentlemen, is our annual payroll.

"'We use enough wire rope in the anthracite industry to rebuild every year the Brooklyn bridge. We use enough asbestos to reproduce the capital at Washington. We have more miles of railroad underground than the Pennsylvania Railroad has on the ground. We do as much excavating in our stripping work in a year as was done in the Panama Canal.

"'The anthracite industry is the greatest engineering feat in the world. We have done the finest piece of Americanization work that has been accomplished in the United States, because the operators insist that their bosses speak English, and the United Mine Workers of America require that all business of every local union be done in English. Practically every miner has learned to speak the language of this country.'"

HIRAM SMITH.

Wilkes-Barre, Pa.

Kinetic Elutriation

To the Editor of "E.&M.J.":

In reference to your editorial in the issue of July 13, making mention of my paper before the Institution of Mining and Metallurgy:

I have for many years held the opinion that the most effective method of maintaining a sufficiently thick water film between all individual solid particles, to enable them freely to interchange their relative positions, is to pump the pulp at slightly above turbulent velocity through long channels of small cross-section, thereby inducing forces which keep the solids in dynamic suspension and consequently free to respond to the classifying stresses of centrifugal force or gravity.

In any system of low-velocity classification, where the heavy particles fall to the bottom of the containing vessel, the mass of settled material not only resists conveyance to its required destination, but also a large proportion of the lighter material becomes entrained by and attached to the oversize particles by molecular forces, which, in my opinion, cannot be effectually overcome, except upon the exposed surfaces of the mass, by any system of mechanical agitators. Hence in my designs of classifiers, my first aim has been to avoid possibility of the particles settling until classification is complete and the products have reached their respective destinations.

An incidental but important feature of this method of classification and conveying is that the wear on the walls of the channels is much less than in any system of classification where the sands settle and are dragged along the surfaces of the channels. This latter conclusion has been definitely substantiated by the experience obtained in conveying, over long distances, ash and heavy clinkers by means of the hydro-jet system of conveyors. LEONARD ANDREWS.

London, England.

Reverse Classification

To the Editor of "E.&M.J.":

I have read with interest Mr. Dyer's article on "Reverse Classification by Crowded Settling," which appeared in your issue of June 29, 1929. From this article, since it contains no references, one gets the impression that Mr. Dyer has made a contribution on an entirely new phase of ore dressing. I wish to call attention to an article by myself entitled "Theory of Stratification and Its Application in Ore Dressing," which appeared in *Mining and Metallurgy*, Vol. 7, No. 238, October, 1926.

In this article I discuss and show diagrammatically not only "Reversed Classifications" under the conditions set forth by Mr. Dyer, but also all of the intermediate types of classification between that understood as hindered settling classification and that type which Mr. Dyer calls "Reversed Classification." The theory of the subject is given. So-called "crowded settling" is only one of an infinite variety of classifications that may be effected by mechanical agitation and water flow.

A. W. FAHRENWALD.

Moscow, Idaho.

Old-Time Reader Sends News From Property in Peru

To the Editor of "E.&M.J.":

About a year ago I took over the Santo Domingo mine, in southern Peru, owned and operated for the preceding 30 years by the Inca Mining & Development Company, which was controlled by the late Senator Lewis Emery, Jr., of Bradford, Pa. The development work undertaken has proved that the mine still contains ore, even though ore to the value of about $15,000,000 has been extracted in the past.

We have been making regular shipments of gold bullion for the last ten months and have sufficient ore reserves to assure production for some time to come.

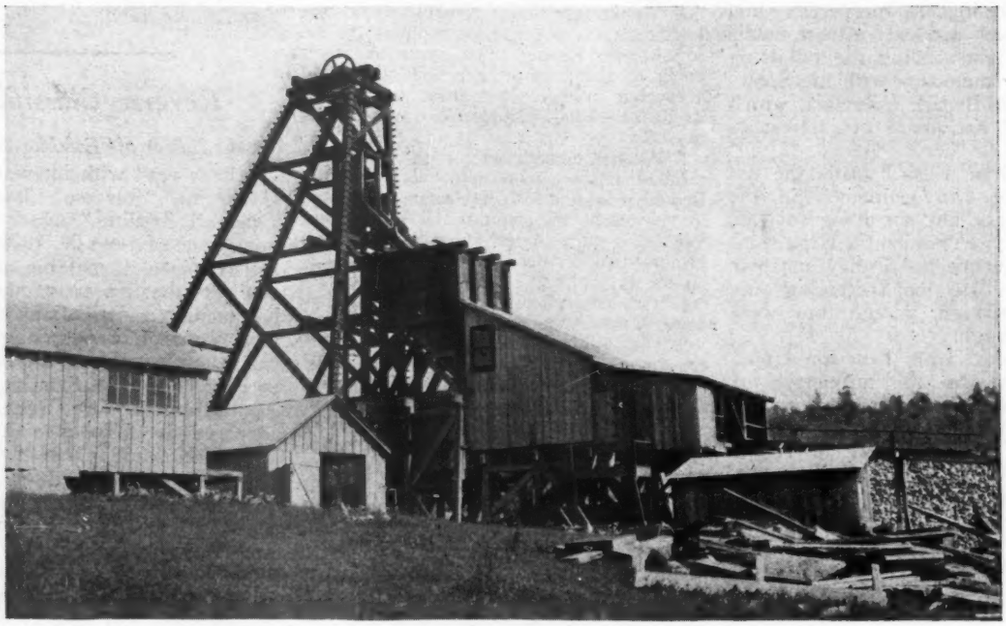
I have been a regular reader of the *E.&M.J.* since 1895, and when I don't have a copy on my desk it will be when I quit the mining game, which I hope will not be for many years yet.

CLARENCE WOODS.

Santo Domingo, Peru.

[Will some other old-time readers come forward with expressions as to how long they have been subscribers to *Engineering and Mining Journal*.—EDITOR.]

Drift Mining at Vallecito



Vallecito Western surface plant

By GEORGE J. YOUNG
Associate Editor

THE present year is the eighty-second of gold mining in California. Within the last 30 years the peak production was in 1915, when 1,085,646 oz. was produced. In 1928, the estimated production was 524,300 oz., a decline from the 1915 peak of 561,346 oz. The causes of this decline are understood to be in part the exhaustion of some mines and in some degree the adverse conditions brought about by the diminished purchasing power of the dollar in contrast with the fixed price of gold, the miner's product. Gold dredging has kept up the gold production for the last 30 years, but this industry is now declining. Lode mining has also declined. Placer, drift, and hydraulic mining have maintained only a very small production when compared to lode mining and gold dredging.

Adverse economic conditions as affecting the gold miner will probably continue for a long time. Operating mines, under these conditions, may resort to selective mining and thus mine ores of higher grade but with smaller tonnage; they may increase their recoveries and effect economies in operation by installing more mechanical and electrical equipment or by replacing old equipment with more efficient machinery; they may radically improve their methods. Such expedients will vary in accordance with the specific conditions at a given property. Present lode mine production is scarcely able to maintain its output, and new properties that reach production do not in the aggregate contribute sufficient to prevent a gradual decline in total production.

The situation is, however, not without possibilities, for there are opportunities in hydraulic mining and in drift mining Tertiary channels. Any general resumption of hydraulic mining is not to be expected, but some deposits favorably situated with reference to débris disposal admit of commercial exploitation. Drift mining, on the other hand, is not seriously subject to the limiting factor of débris disposal. Its past record has both bright and dark spots. A good deal of money has been lost in drift-mine enterprises. Nevertheless, there are many records of successful mining. Other kinds of mining have more generally occupied the limelight and engaged the attention of technicians and geologists. The more or less accepted belief in the ephemeral nature of placer mining was also a handicap. Under such circumstances, that this kind of mining became inconspicuous in California and retrograded is not surprising. Half-hearted attempts were made from time to time, but as no outstanding success was achieved, drift mining became the poor relative in the gold-mining industry of the state.

Like the handy piece of metal that is tucked away in the corner of a Scotchman's house to await a future need, the dormant possibilities of drift mining finally attracted the attention of mining men out of a job, and a few of these men have become interested and are now revitalizing this industry.

Drift mining needs more geological investigation. There is an interesting field not only for the general geologist who is specializing upon Tertiary and post-Tertiary geology, but for the mining geologist who is looking for commercial deposits. Lindgren, in Professional Paper 73, 1911, has made the best summation of the subject that is now available. However, a good deal can be added, and if success is to be attained in present-day drift mining it is essential to build up a more intensive geological background and more specific criteria as well as detailed mapping of significant areas. To work

out as accurate a record as possible of past efforts in drift mining is also necessary.

Mark A. Alling, who made a study of Tertiary gravel deposits, but whose reports are not easily available, states the situation as follows:

"Although much has been written on the subject of ancient river beds of California, few authors have sufficiently analyzed the geology to aid materially the prospector in driving his pick into the 'pay.' A detailed study is needed of the successive geological steps and their significance within a certain field, and the establishment of definite standards as to order of occurrence of channels and their respective fillings; so that the miner can actually use the information and spend his time and money developing only deposits of the more promising types. One may write a book on the value of deposits already worked out, but what are needed now are men who can apply knowledge gained through the comparison of channel deposits, who can trace deposits superficially, explain the causes for certain effects, and direct the miners to the pay streaks.

"Channel mining, like all other kinds of mining, has been followed by men of every class—by the novice and by the experienced, by the penniless prospector and by the well-financed company. All kinds of mining work have been prosecuted under all manners of theories; and, considering the judgment displayed by many, it was only due to the great richness of deposits that success resulted. Many so-called mining failures never reached the mining stage. Some were financial schemes only. In other instances the operators were totally inexperienced and unfit; they would have failed in any other business undertaken with the same limited amount of preparation. Most of the failures suffered by experienced individuals or companies have occurred in prospecting for the channels, not in mining within them. Few signal failures have occurred where any of the earlier types of channels have actually been found and properly developed. On the contrary, the records of drift mines that were operated show that many paid unusually large profits on the investment. The need of a better understanding of channel geology, so that good work can be more intelligently directed, is indicated."

Finding buried channels that contain gold in paying quantities is the crux of the situation. Mark Alling distinguishes seven types of river channels, beginning with the primary or white quartz gravel channels and ending with the modern river beds. Of the intervolcanic series his classification includes the "shallow red leads," the "deep blue leads," the "deep red leads," the "porphyritic channels," the "inter-andesitic channels," and the "inter-basaltic channels." Thus, beginning with the primary river beds, subsequent geologic changes have superimposed successive periods of erosion and deposition, which have resulted in the present-day complication of structure.

More than ordinary ability is required to unravel the erratic disposition of the gravels. The older miners operated under special difficulties, although they had the advantage of low-cost labor. Water was one of these limitations, and, to avoid pumping, long adits were driven. This is no longer necessary, as power and pumping equipment can be readily installed and water handled efficiently. Electric locomotives are available for transportation and miscellaneous mining equipment is at hand for working.

The present-day miner has many advantages as compared with his predecessor in drift mining. Even in the finding of the buried channel the advantage is with the present-day miner, although much still remains to be worked out in Tertiary channel geology. Whether geophysical methods will be efficient in aiding prospecting remains to be seen. Some work of this kind has already been done. Arthur Gibson[1] employed magnetometer surveys, as did K. C. Laylander.[2] Apparently black sand concentrations are necessary for the method to be successfully applied. These are not always a feature of the Tertiary river channels. Geological mapping with supplementary drilling is the method that experience has developed.

The success of Don Steffa, Thomas H. Lipps, A. H. McKenzie and associates in locating and developing a segment of one of the Tertiary channels near Six-Mile Creek between Angels Camp and Vallecita has excited others to initiate new work in the vicinity. The Vallecito Western Mining Company is Don Steffa's company. West of Six-Mile Creek is the Calmo and the Victor mine of the Calaveras Central Mining Corporation, and northwest of the Vallecito Western is the Butte Mining Company. At Douglas Flat, northeast of Vallecito, Adolph Kreye and associates are operating the Douglas Flat Mining Company. All of the properties are opened by shafts. Some years ago the Thomas B. Bishop Company, which owned large tracts of land near Vallecito, engaged Mark A. Alling to make a geological investigation of the area, and this was done, a work that occupied a period of six years.

The Victor Central property has been operated off and on for some 30 years. John C. Benson sank the present shaft in 1904-5. Years before this time the region of the Calaveras Tertiary channel and the Columbia channel was worked by hydraulicking and by drift mining. W. H. Storms[3] described the region in 1894.

Steffa and his associates became interested in the Vallecito area in 1920 and sunk a shaft on the north side of Vallecito Valley on a segment of the Columbia Channel. From this about $10,000 was secured and the shaft was abandoned. A detailed study of the region was next made, and as a result a portion of the Bishop tract was secured upon a royalty basis and a line of drill holes was sunk east of Six-Mile Creek. The cost of this work was $13,000. Drilling was started in May, 1923. The channel was discovered and a shaft sunk (May, 1924). Drifting on the channel started, and although first results were not encouraging, the channel soon showed gold, and development was continued until two more or less parallel drifts have been extended 2,173 ft. and crosscuts have been driven to the outer margins. The longest crosscut is 212 ft. Maximum width of the channel is about 300 ft. The pay lead in the channel is narrow, the breasting width being from 60 to 80 ft. Total development work is 5,300 ft. All of the gravel excavated in development has been washed, and it is estimated that in the length of channel now developed about 50,000 tons of gravel can be mined and profitably handled.

Overburden at the shaft is 153 ft., the first "pay" being found 23 ft. above bedrock in the drill holes. At the end of the development a second shaft is to be sunk, the depth of overburden being 242 ft. The uneven bedrock is slate at the west end and granite at the east. Filling consists of large boulders up to three or more feet across down to the fine interstitial material which is compact enough to make the workings self-supporting, but is not cemented enough to interfere with washing. A large proportion consists of head-size boulders. There is little evidence of classification, and the previous character of the stream appears to have been torrential. Granite and schistose rock, some limestone but very rarely quartz, make up the coarse filling. Bedrock concentration of the gold is not conspicuous, although in some

[1] *E.&M.J.*, Vol. 114, p. 1064.
[2] *E.&M.J.*, Vol. 121, p. 325.
[3] Twelfth Annual Report, State Mining Bureau of California.

Central Hill channel, which was drifted and then hydraulicked

places the bottom gravels to a distance of 18 in. above bedrock run $40 per ton. The gold consists of coarse flat flakes and is distributed from bedrock up to a distance of 9 or 12 ft. The channel is not considered to be a primary channel.

Production to date has been about $100,000. In August, 1927, $4,195 was taken out in 29 days; in October, 1927, $9,488 was produced, and in November, 1927, $7,774 in 23 days. During the last two years production has paid operating expenses on a development program. At the end of the drifts the gravel showed signs of a change in the channel. It yielded $16 per ton. The last 13 tons before drifting was discontinued produced 48 nuggets.

Some nugget gold, usually greatly worn, has been found from time to time. However, some of the gold in the last workings was distinctly crystalline and some was wire gold. One piece of ground 100 ft. long by 35 ft. in width produced a total of $31,000. These figures were given to me by Mr. Steffa, and indicate the general richness of the segment of channel developed. Water flow is 40 g.p.m. and has not varied for about three years. The principal flow originates in an underground "spring" associated with a minor fault which apparently cuts the channel. The expense for drainage is about $30 per month. Sixteen men are employed, and in April, 1929, 22 tons of gravel per day paid operating expenses.

Plant at Vallecito Western

One of the advantages of drift mining is the comparatively simple plant required for both mining and gravel washing. The hoist is a single-drum, geared, motor-driven Hendrie and Bolthoff machine. A short center belt-driven, single-stage compressor supplies compressed air. The tool-sharpening shop is equipped with an Ingersoll-Rand oil forge and drill sharpener. A "Beam" turbine pump is used for drainage. This consists of a column pipe in which a vertical shaft and propeller operate. The shaft is coupled directly to a vertical motor which is at the surface, the column pipe being in one compartment of the two-compartment shaft. The pumping rig is one of the simplest, and its operation requires a minimum of attention. One compartment of the shaft is equipped with a two-ton skip and the other with ladderway and pump column.

The skip dumps into a bin which discharges upon a 9-ft. length of sluice discharging into a trommel 18 ft. in length. Large cobbles are removed by forking and dropped into a mine car for removal to the dump. The trommel is equipped with 1¼-in. and ⅜-in. punched plate screens, the oversize being discharged into a sluice and the undersize passing into short sluices and over a coarse wide screen which serves as a riffle to catch the gold. A sluice 16 in. wide and Hungarian riffles receive the screen discharge.

Several baffles are placed along the sluice line which leads to the dump. The short sluice below the trommel has a grade of 2 in. to the foot and below the screen the sluice grade is 1¼ in. per foot. As the gravel easily disintegrates and the gold is coarse, little difficulty is experienced in saving a high proportion of the gold. On the completion of the second shaft it is planned to begin production operations upon the basis of 150 to 200 tons of gravel per day.

Calaveras Central Mining Corporation is developing a channel property west of Six-Mile Creek and north of Altaville near Angels Camp. The Victor mine, as it is called, is served by a shaft 360 ft., the second level being at the 339-ft. point. About 5,000 ft. of workings has been completed, mostly on the south side of the channel. Harry Sears, general manager, estimates that some 15,000 tons, part bedrock and part gravel, has been removed and that the total production is about $100,000. As in other gravel properties of the region, a good deal of exploration is necessary before the "complex" of old streambeds is understood. At present Mr. Sears is planning to crosscut the wide channel on his ground and to search for connecting channels which have entered from the south. He states that where gold is found it occurs as a bedrock concentration. The grade of the channel

between the Victor and the Jupiter to the northwest is only 6 ft. to the mile, indicating different conditions as compared with channel grades in the Vallecito area.

The Victor shaft contains three compartments, two skipways and a pump- and ladder-way. A Sterling turbine pump, 4-in. discharge, drains the mine, the pump and motor being on the lower level. The discharge is about 120,000 g.p.d. Compressed air is supplied by a Sullivan angle-compound belt-driven compressor. The hoist is a double-drum gear-driven type with motor drive. Skips are of 2½-ton capacity.

The gravel-treatment plant is planned for one-man operation. From the receiving bin the gravel flows through a control gate to a revolving trommel from which oversize is discharged upon a belt conveyor by which it is delivered to the dump; undersize, minus 1½ in., is received in a sluice in which baffles and riffles catch the coarse gold. The sluice discharges into a short revolving trommel, oversize passing by belt to conveyor to the dump and undersize, minus ¼ in., passing by sluice to a drag classifier, which in turn discharges oversize into the feed hopper of a Rexman rod mill. The 20-mesh discharge of the rod mill is passed over plates and through three mercury traps, the first two of which are charged with mercury. It is planned to treat the concentrates obtained on the last trap in amalgamating barrels. W. H. Warwick is superintendent of operations.

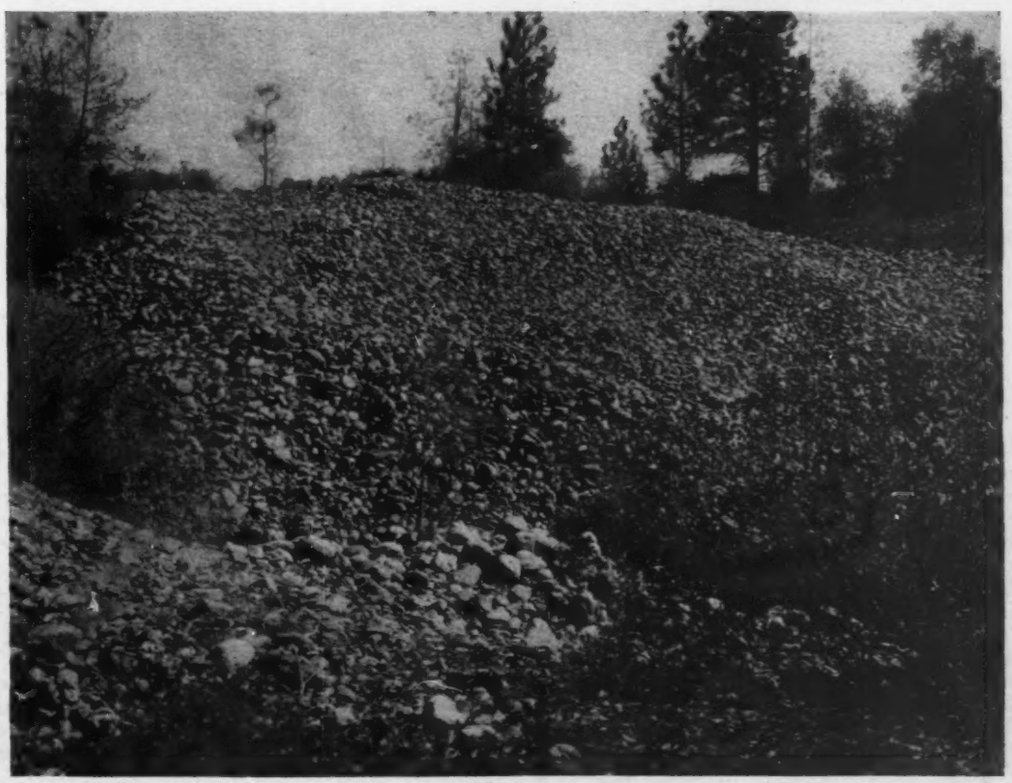
Between the Victor mine and the Vallecito Western is the Calmo property, which has a shaft 167 ft. in depth with a sump to the 200-ft. depth. A Fairbanks-Morse centrifugal pump of 650-g.p.m. capacity and 40-hp. motor provides drainage, the water flow being 130,000 g.p.d. Some 8,000 ft. of work has been done, and a channel of 70 to 125 ft. has been worked to some extent. Where gold has been found it is concentrated upon the bedrock. The gravel is similar to the gravel taken from the Victor and also resembles that on the cobble dump of the Vallecito Western. Development and exploration are in progress.

Butte Mining Company is sinking a substantial shaft and was at the time in bedrock. Douglas Flat Mining Company, northeast of Vallecito, has sunk 90 ft. in bedrock and is preparing to develop a segment of a channel. It is equipped with a motor-operated, single-drum hoist and a Beam turbine pump of 300-g.p.m. capacity. About 100 g.p.m. is being pumped.

The principal incentive of the drift miners in the Vallecito-Douglas Flat area is the Central Hill Channel, with its probable southern affluent from the direction of Columbia. Central Hill Channel was mined at Murphy and southerly from that point both by drift methods and hydraulicking. It proved to be rich, as did the affluent (the Columbia Channel of Storms) south of Vallecito, which was hydraulicked. Continuation of these channels was sought for in Douglas Flat and Vallecito. Without much doubt there were a number of strands and a complex of channels within these areas as well as to the west near Altaville.

A large amount of work is necessary to unravel the old channel system. The Vallecito Western company has accomplished the most significant work in the area, and has definitely proved one of the channels. That this is not the only channel has been recently proved by driving a long crosscut northerly and the discovery of rich gravel in what appears to be another strand. W. H. Storms, in the Twelfth Annual Report of the State Mineralogist, shows a map of the area which indicates several channels joining at a point north of Vallecito and continuing to the west as a main trunk channel. Within the developed channel of the Vallecito Western the grade is about 50 ft. to the mile. Above Six-Mile Creek the channel grades have increased and are from 75 to 85 ft. to the mile. Northwest of the Victor property the grade decreases rapidly.

A thorough study of the area should be made, not only for its geological significance but because the units would materially help the miners now operating in the area.



Portion of the once-worked Columbia channel. This was hydraulicked.

By the Way

When a Catch Phrase Becomes Reality

THE "gold-digger" was so named because of her ability to extract the yellow metal from deposits no deeper than the trousers pocket. Now, if we are to believe reports from the almost incredible Golden State, some hardy Hollywood heroines are going to become gold-diggers in reality. A group of actresses, led, appropriately enough, by Clara Bow, has acquired the Belmont and Seneca mines, in Sierra County. Whether the acquisition is to be an investment or a new form of whoopee is not stated. Pete Flower is in charge of operations. Lucky Pete!

Saving the Burnt Child

THE burnt child dreads the fire, and so will those Arizona school children, although unscathed, who witness the Labor Day celebration at Bisbee. A safety object lesson of unusual effectiveness has been planned for that occasion. A dummy in the form of a boy holding in his hand a dynamite cap will be placed in the center of the ball park and the cap will be exploded by electricity. The hand holding the cap will be of some material of the same toughness as the human hand. The damaged hand will be placed on display in the schools, together with an unexploded cap. Teachers will also be provided with material for a lecture on the dangers of detonators and other explosives even when handled by experts.

Stockholders Get Plant Inspection Passes

ANNUAL passes entitling the holder to inspect any of the many factories of the General Electric Company were mailed to the 55,000 stockholders of the company with their dividend checks on July 26 last. The passes, signed by Gerard Swope, president of the company, are good until Dec. 31. On the reverse side of the passes are listed the cities where the company has factories, with a brief summary of what is manufactured in each plant.

[The large majority of stockholders in industrial enterprises lack more than a cursory knowledge of the plant operations of the companies in which they invest. A more intimate understanding of this phase of industrial activity on the part of the stockholder is advisable, inasmuch as it reacts to the benefit of both the investor and the company. The aforesaid action of the General Electric Company in issuing the passes is noteworthy and should result in large numbers of the company's stockholders taking advantage of the privilege the passes offer.—EDITOR.]

The Modern Captain of Industry

THE extent to which the movement toward planned production and distribution can continue to grow without being overwhelmed by the vastness of the undertaking itself depends to a large extent upon the human element. . . . An industrial policy is called for that is neither predatory nor altruistic, and when that policy has been found, it must be energetically administered: The danger that business to the extent that it is systematized and raised above the pressure of competitive rivalry will lapse into the inertia that characterizes routine operations—become in short bureaucratized—is without doubt great. . . . Whether there are enough men with the ability to govern the new type of integrated industry and the firmness to insist upon the maintenance of high standards of achievement is a question that only time can answer. No matter what the particular form that a co-operative, a "rationalized" or a combined industry happens to take, it is evident that its success will depend in final analysis upon a few leaders invested with the powers to act for the co-operators, the shareholders or the individual industrial units that have been brought together to form an economic entity.—*Journal of Commerce.*

Kafir Motive Force

A METHOD of power application of unusual simplicity has been discovered at an experimental plant on a platinum property in South Africa. This unit, shown in the accompanying sketch, drives a small Dorr thickener

A 2-r.p.m. 1-Kafir-power drive unit

at about 2 r.p.m., the motive force being supplied by a Kafir who perambulates slowly around the tank while pulling a rope attached to a crank projecting from the central shaft. In addition to other possible advantages, this type of power drive is said to require neither a cut-out switch nor an overload alarm.

Consultation

Why Tungsten Prices Have Increased

"Can you tell me what has caused the recent increase in tungsten ore prices, which in the last six months, according to your quotations, have risen from $12 to $17 per short-ton unit of tungsten trioxide in the form of wolframite delivered at New York?"

Low stocks of tungsten ores, both in Europe and the United States, plus heavy demands abroad and in this country on the part of manufacturers of high-speed tungsten steels, have resulted in increased prices. Although bids are being made by dealers for Chinese ore, little is leaving that country. The political situation there is believed by some authorities to be responsible for the marked curtailment in shipments.

The situation as seen from a European viewpoint is presented in the following excerpt from a recent issue of *The Statist* (London):

"Up till the end of last year China was able to ship from 100 to 250 tons of wolfram concentrates a month. Recently, however, shipments have been postponed, in some cases for two or three months, and it is believed that surface deposits there are almost exhausted, though it must not be overlooked that a great deal has yet to be known of the mineralization of China. Consumers have been complaining of the presence of arsenic in recent arrivals, and the shipment of a separator to the fields suggests the Chinese are now having to mine for the ore and that, in consequence of the crushing and separating which will in future be necessary, costs will rise.

"Other producers, such as those in Portugal, the Federated Malay States, Bolivia, the United States, and Great Britain—who have always had to mine for the ore—may be expected to benefit from the abatement of Chinese competition. Figures of the world production for the fifteen years 1913-1927, in tons, follow:

1927	1926	1925	1924	1923
13,000	12,500	10,000	6,400	7,700
1922	1921	1920	1919	1918
10,300	5,700	7,900	18,200	34,600
1917	1916	1915	1914	1913
27,900	23,600	11,800	7,800	8,900

"The above figures, it should be added, are based on 60 per cent concentrated material. Statistics for 1928 are not yet available, but the production was probably above that of 1927. If the year 1922 is excluded as exceptional, it will be seen that the production of wolfram during the last four years (including 1928) has been considerably above the pre-war average, and the rise in the price of wolfram shows that this increase in production is in response to a growing demand. The immediate indications are for the price of wolfram to appreciate further."

Personal Notes

R. A. Kinzie, mining engineer, of San Francisco, has returned from Alaska.

J. Y. Murdoch, president of Noranda Mines, has resigned as a director of Newbec, also in the Rouyn district of Quebec.

S. E. Stein, metallurgical engineer, has left New York City for Los Angeles, where he expects to remain for several months.

J. Richard Brown, mining engineer, of Spokane, is in charge of operations for the Red Top Mining Company, near Colville, Stevens County, Wash.

J. C. Houston, mining engineer, is in charge of operations on the holdings of the Mormic Mining Company, in Deroche Township, near Bellevue, Ont.

Charles J. Adami, manager of St. Joseph Lead, is returning to his home in St. Louis, after visiting mining districts in Idaho, British Columbia, and Alaska.

A. R. Lawrence, for the last five years with Inspiration Copper, and formerly with Phelps Dodge, is now superintendent at the Howey mine, Red Lake, Ont.

Dr. Marshall Haney, of Geer, Va., has completed a geological survey of the cement rock and granite in the territory served by the Georgia & Florida Railroad.

A. A. Boyd, general manager of the old Mount Morgan Gold Mining Company in Queensland, Australia, is in charge of operations for the new owners at the mine.

Duncan Smith has returned to Brussels after a month spent in France. While in the Auvergne district, Mr. Smith visited the amethyst mines and Glozel.

Benjamin F. Hill, mining engineer, who is developing his own properties in the Cripple Creek district of Colorado, is inspecting the Pinnacle and Ophir projects as consulting engineer for **Zeb Kendall.**

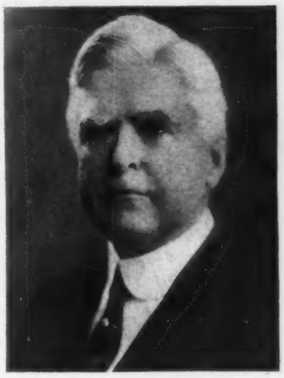
Arthur B. Brown, who has been associated with **E. S. Giles,** consulting engineer, of Goldfield, Nev., has resigned to resume post-graduate studies at the University of Nevada in paleontology and oil geology.

H. M. Lawrence, metallurgist of the U. S. Bureau of Mines on phosphate beneficiation, has been detailed from the Southern experiment station at Tuscaloosa, Ala., to the land-pebble phosphate district in Florida.

S. R. Zimmerley, for the last five years at the Salt Lake station of the U. S. Bureau of Mines, has resigned to take a position with the Sullivan Mining Company, at its electrolytic zinc plant at Kellogg, Idaho.

X. B. Starnes, who was in charge of the geological department of the Morenci branch of the Phelps Dodge Corporation, is now geologist with the Copper Queen branch of the same company at Bisbee, Ariz.

George S. Rice, chief engineer of the U. S. Bureau of Mines, has been awarded the medal of the Institution of Mining Engineers, of England. The award, contained in a resolution adopted



GEORGE S. RICE

unanimously by the directors, is, "In recognition of his eminence in all matters relating to the safe working of coal mines and the well-being of mine workers, with special reference to the practical application of scientific knowledge."

Fenwick P. Caddy, mining engineer, of Victoria, B. C., has been appointed assistant to Dr. **J. T. Mandy** in the northwestern mineral survey district of British Columbia, under the Mineral Survey and Development Act of that province.

E. J. Raddatz, president and general manager of the Tintic Standard Mining Company, is spending a month in La Jolla, Calif., where he was met by his son, **Harold Raddatz,** and **James W. Wade,** assistant general manager of Tintic Standard.

Stanly Easton and **Harry L. Day** will preside at the first day's meeting of the Western division of the American Mining Congress, in Spokane, Wash., on Oct. 1. **H. G. Washburn** and **W. B. Daly** will be chairmen at the following day's sessions.

F. C. Mulford, of the technical staff of Patiño Mines & Enterprises, is on a trip through the United States, during which he will observe trends and progress in ore-treatment methods in various parts of the country. He expects to return to Bolivia in three months.

J. B. Haffner, general manager of Consolidated Coppermines, at McGill, Nev.; **John Fulton,** director of the Mackay School of Mines at Reno, and **Louis Ware,** who is doing consulting work for Consolidated Coppermines, have been visiting Arizona copper camps.

Charles E. Locke, of the Massachusetts Institute of Technology, is visiting various mining regions in the United States, prior to attending the regional meeting of the A.I.M.E. at San Francisco, after which he will leave for Japan, to attend the World Engineering Congress.

M. I. Singer, formerly engineer for the Illinois state highway department, has been appointed assistant professor of mining at the Colorado School of Mines, filling the vacancy caused by the resignation of **T. M. Bains, Jr.** Mr. Singer is a graduate of the Missouri School of Mines.

Frederick MacCoy and family have left Mexico City for Berkeley, Calif., where they will make their future home. For the last ten years, Mr. MacCoy has been general manager of the San Rafael Mining Company, and a director of the American Chamber of Commerce. He was one of the founders and is still a director of the Mexican National Chamber of Mines.

S. Power Warren, metallurgical engineer, has returned from a sojourn of six months on professional business in England and Spain. Mr. Warren will attend to Canadian professional engagements, returning directly to Golden, Colo., to resume his duties as associate professor of metallurgy at the Colorado School of Mines, from which he was granted leave of absence early in the year.

OBITUARY

Alexander J. Mitchell, who was for forty years a mining and civil engineer in Denver, Colo., died in Los Angeles, Aug. 28. Mr. Mitchell was 78 years of age.

A. F. Gladding died in Oakland, Calif., Aug. 21, 1929. He was long associated with the firm of Gladding, McBean & Company, pioneers in the clay and ceramic business in California. He entered the firm in 1875 and until 1923 was actively engaged in the business as first vice-president. His father established the business. Mr. Gladding was 71 years of age.

G. H. Crawford, well known in mining circles in the early days of Bendigo, Victoria, Australia, died recently at that city at the age of 83. Mr. Crawford was identified with many of the important mines of the field. For some years he was a member of the Bendigo Mine Owners' Association, and the Legal Managers' Association; he served on a royal commission on gold mining in 1889 and, as a representative of the Victoria government, was on a board of inquiry regarding mine managers' certificates. During a visit to England in 1893, Mr. Crawford floated the Frederick the Great Gold Mining Company.

Which Mine Car, and Why?

ORE transport is such an important phase of mining that any improvement made in it has a decided effect in lowering the total cost of operation. Every ton extracted must be carried at least part of the distance between the surface and the face where it is broken. Ways and means of transport are therefore worth careful study.

Unfortunately, the nature of mining generally compels the use of small, seemingly toy-like cars. Transport on this account must needs be inefficient at the outset, as compared with surface handling. Conditions of service, moreover, are severe. Cars get a minimum of care, are often badly treated, and the poorly built car suffers unduly in consequence. Likewise, the type of car must be suited to average conditions with respect to dumping or transfer to the surface, if further loss of efficiency is not to result. For these reasons the mine car is well worthy of attention and study.

Such study should concern itself with selection as to type and size; with quality of design and construction, including the use of anti-friction bearings and proper means of lubrication; with the question of the advisability of building cars at the mine plant as compared with purchasing them; and with the lesser but still important matter of buying car wheels or else making them, and of what material. The discussion in this issue will be limited to the topic of selecting the type and size of car. Other phases will be considered at a future date.

Cars are to be had in so many types and sizes that the task of selecting one for some particular service may be anything but easy. In them is demonstrated how even an inanimate thing may reflect environment. More than this, in the multiplicity of design and detail they reveal the ingenuity or caprice or, at times, the shortcomings of the designer.

The Interested Parties

Broadly speaking, two classes of individuals are called upon to make selection of mine cars—namely, the mine operator and the mine-car manufacturer. Each looks at the problem from his particular point of view.

The operator wants a car that in respect to type and size will be suited to the underground conditions peculiar to his mine. He must consider such factors as width of drifts and crosscuts, dimensions of the hoisting compartment in shaft or winze, the tonnage desired, the specific gravity of the ore, and also whether it is wet or dry and how coarse it breaks; he must also take into account the method of loading, hauling, and hoisting, the dumping facilities existing or capable of being provided, and, in some operations, even the attitude of the local workman. Whether the mine is a prospect in an early stage of development or a property worked for

The too-particular operator and the one who is easily suited get together for an informal conference on transportation costs. Both have four or five different kinds of mine cars. (Brown likes a car for every condition underground. Smith buys job lots of second-hand cars from time to time, because he gets them cheap.)

years, most or all of these points must be considered. Moreover, the operator requires a car that will stand hard service. Use and abuse are often the same where mine cars are concerned.

That the manufacturer also may be called upon to select a mine car may seem strange but is, nevertheless, a fact. A wide variety of cars are on the market. A manufacturer's line is often quite diversified. In the effort to meet many different conditions and the divergent views of many operators, he may have built up a line of widely varying types and sizes. To operate his plant more efficiently, he may wish to drop some of these models. Which shall he retain? Or he may wish to pick out the model that will have the widest application and suit the greatest number of operators, in order that he may feature it in advertising. Which one will it be?

Operator and manufacturer, confronted with the problem of selection, have the same thought at the outset. Each would like to know what the prevailing practice is in his respective field. The operator wishes to find out what other operators are using. To guide himself by the experience of others is, in general, safer than to pioneer, although the latter sometimes has profitable results. The manufacturer simply must find out what types of cars are in greatest service if he is to make a wise selection. Such knowledge can be gained only by investigation.

From the operator's point of view, the inquiry may be twofold. He wishes in any case to know what cars are being used for main haulage purposes. In some mines, however, a distinction is made as to phases of haulage. If part of the system may be classed as intermediate, the operator also will want to know what cars are used for it as well. Sometimes scrapers take the place of cars on intermediate levels. Where both phases of haulage exist, or, in a new project, are planned, two types of cars may be required, or possibly two sizes of the same type. From the manufacturer's viewpoint there is no choice—the inquiry must be twofold.

Car Facts

A survey of the mining field (excluding coal) shows how the practice and preference of operators varies with respect to mine cars. Practice and preference are not always the same. Under some conditions, the operator would make a change, but cannot, because of the size of workings or other irremediable conditions. The practice of thirty companies (see Table I), representing collectively a fair cross-section of the mining industry and geographically all of the principal mining states, is considered in the following:

For main haulage purposes cars of six general types are being used by the companies considered. They are:

1. Rigid-box type, requiring rotary dumping.
2. Rocker dump.
3. Gable bottom.
4. Granby type.
5. End dump.
6. Bottom dump.

In general features these types are so familiar as to require no description.

Table II shows the operators who are using each of the several types. Some companies are using more than one. In some operations this is the result of a desire to experiment; in others it is due to varying conditions in the same mine or in different mines belonging to the same company. This condition also may arise where properties have been merged.

Eight of the operators are using for main-haulage purposes the rigid type of car, six the rocker dump, seven the gable bottom, two the Granby type, seven the end dump, and four the bottom dump. Clearly, the operator who

seeks guidance by observing the practice of others will find little to help him in this distribution on its face. Further study of facts will prove worth while.

Rotary or tipple dumping, used for emptying the rigid box-type car, in the opinion of the superintendent of an Arizona copper company, is justified only where cars of large capacity must be moved and dumped at high speed—where tonnage is large. An iron-country operator thinks that there is a point where a properly constructed dump and the rigid-box car can be employed to advantage, because upkeep of the car is less and its capacity for the same overall dimensions as those of other types is greater, so that heavier tonnages can be handled and, at the same time, space clearances be maintained without changing the width of haulage drifts.

The 6-ton cars used by company No. 9, in California (see Table II), in connection with rotary dumping, serve to carry the ore from mine to mill, the mine haulage system being about three miles long. About 900 tons per day is handled over this distance in two eight-hour shifts. This company, in one of its mines where the stopes are large and finger chutes 3 ft. wide at the lip are provided, is using 1-ton round-bottom rocker-dump cars to insure ease of loading and dumping. This car requires two men to dump it, but because of the rapidity with which it can be filled and emptied, fewer cars are needed to maintain maximum output without congestion.

The rocker-dump type appears to be in greater favor than the gable-bottom car, although the latter is preferred by some operators. Of the companies in Table II which are employing the gable-bottom car, No. 12 would standardize on a rocker-dump car, if it could afford to scrap the others, although if its ore deposits were larger it would prefer rotary dumping with cars to suit. Company No. 3, which standardized on both the rigid-type and rocker-dump cars ten years ago in one district, would standardize on the rocker dump or the Granby type, if equipping new mines today.

Table I—Companies Surveyed

Company		Location	No. of Cars in Service
1	Prominent mining company	Missouri	Not given
2	Large copper-mining company	Arizona	Not given
3	A large independent iron-mining company, Lake Superior region	Michigan and Minnesota	245
4	Another large independent iron-mining company, Lake Superior region	Michigan and Minnesota	..... Not given
5	Large independent iron-mining company, Birmingham district	Alabama	315
6	Fluorspar-mining company	Southern Illinois	18
7	Important mining company	Utah	768
8	Large-mining company	Nevada	Not given
9	Large mining company	California	Not given
10	Fluorspar-mining company	Southern Illinois	20
11	Zinc-mining company	Wisconsin	100
12	Small independent iron-mining company, Lake Superior region	Michigan	20
13	Gold producer on Mother Lode	California	200
14	Progressive zinc-mining company	Tennessee	230
15	Large gold mine, old settled practice	.....	Not given
16	Large zinc property	East	35
17	Large copper-mining company	Michigan	Not given
18	Large lead-silver mining company	Northern Idaho	Not given
19	Large copper-mining company	Arizona	230
20	Small copper-mining company	Montana	25
21	Large mining company	British Columbia	Not given
22	Large lead-silver mining company	Northern Idaho	Not given
23	Copper company, operating two or three mines	South	125
26	Small gold-mining company	Colorado	10
27	Small copper company	Arizona	75
28	Small copper company	Arizona	6
29	Gold-silver-lead-copper company	Sonora, Mex.	90
30	Gold-silver-copper company	Utah	120

Table II—Type and Size of Car Selected for Main Haulage

Rigid Type Requiring Rotary Dump

Company No.	
1	48 cu.ft.
2	5 tons
3	64 cu.ft.
5	2½ tons (37 cu.ft.)
7	4 tons (75 cu.ft.)
9	6 tons (chalcopyrite)
14	40 cu.ft. (1.9 tons)
17	7½ tons (150 cu.ft.)

Rocker Dump Type

Company No.	
13	20 cu.ft.
16	1 ton (20 cu.ft.)
9	1 ton
19	32 cu.ft.
3	35 cu.ft.
	65 cu.ft.
	76 cu.ft.
4	40 cu.ft.
	50 cu.ft.

Gable-Bottom Type

Company No.	
2	4 tons
12	3 tons. Would standardize on 2½- or 3-ton rocker dump car. For larger deposit would prefer rotary tipple.
15	1 ton (20 cu.ft.)
3	65 cu.ft. but would standardize on rocker dump or Granby type, if equipping new mines.
4	Has some gable bottom cars in use but is standardizing on rocker dump.
29	1½ tons
25	4 tons.

Granby Type

Company No.	
21	
3	

End Dump Type

Company No.	
6	1½ tons (25 cu.ft.)
10	1 ton (20 cu.ft.
11	1½ ton (30 cu.ft.)
15	1 ton (20 cu.ft.)
17	7½ tons (150 cu.ft.)
20	(development only) 16 cu.ft.
23	60-90 cu.ft. (lifted by air cylinder)

Note—The companies named above using the end dump car for main haulage are either small or, in case of Company No. 17 and Company No. 15, are old companies, more or less committed to old-fashioned methods. Company No. 20 is doing only development work at present.

Bottom Dump Type

Company No.	
18	82 cu.ft.
	140 cu.ft.
22	40 cu.ft.
8	Size not given
25	4-ton

Note—The ore of both Company No. 18 and Company No. 22 breaks fine. Otherwise a bottom-dump car would not be practicable.

Changing Practice

The evolution of this company's mine-car practice in another district is interesting. Its old standard for main level haulage was a 65-ft. gable-bottom car, and many of these cars are still in use. Later, several rotary dumps were installed with rigid-box cars, many of which are also used today. The latest installations have been rocker-dump cars of various sizes (35, 65, and 76 cu.ft.), depending on local conditions. The smaller cars were intended for hand loading and for mechanical loading with both loaders and scraper slides. Larger sizes, intended for chute loading, have also been fitted with scraper slides. Some of the latest cars have been of the Granby type.

Company No. 4 likewise has both gable-bottom and rocker-dump cars, but is standardizing on the latter. No. 21 prefers the Granby type where it can be used conveniently; otherwise the gable-bottom type. This is borne out by the fact that it is using the former for main haulage and the latter for intermediate in its principal mine. This operator's tonnage is large. Incidentally, in its various properties it uses about every type of car designed, but the principal mine referred to, from which the great bulk of the tonnage comes, is the only one offering a serious haulage problem.

The Hoary Dean

Of the six types, the end dump has been the longest used. Where tonnage is small, or ore cars are hoisted on cages, either because the skip stage has not yet been attained or because it is necessary to keep several grades of ore separate, the end-dump car is found convenient. It does not lend itself to rapid dumping and so is not well suited to main haulage work where large tonnages must be handled. The companies

Table III—Intermediate Haulage

Rigid Type

None

Rocker Dump Type

Company No.	
9	1 ton

Gable Bottom Type

Company No.	
2	4 ton
21	3 ton
15	(some—1 ton)

Granby Type

None

End Dump Type

Company No.	
3	(Minn.) 1 ton (15 cu.ft.)
3	(Mich.) 37 cu.ft.
7	20 cu.ft.
9	1 ton
14	26 cu.ft.
4	42 cu.ft.
17	3¾ tons (about 75 cu.ft.)
15	1 ton (about 20 cu.ft.)
18	21 cu.ft.
19	16-18 cu.ft.
24	15-30 cu.ft.
10	1 ton (about 20 cu.ft.)
8	1 ton
29	¾ ton

Bottom Dump

None

Note—1. Scrapers take the place of cars for intermediate haulage in many operations.

2. Tipples rarely used on intermediate levels. Hence no rigid-type cars.

listed in Table II, as using this type of car, are either small, with the exception of No. 23, or, in the case of Nos. 15 and 17, are old companies having a large number of still serviceable cars of this type.

Company No. 10, a fluorspar operator in Illinois, finds the one-ton end-dump car particularly adapted to the type and size of its ore occurrences, the deposits being thin and, at times, long, narrow, horizontal beds. A larger car would be impracticable and unwieldy. No. 20 is doing only development work at present. Company No. 6, now using a swivel end-dump car, would prefer a gable-bottom car, on swiveling trucks, if it could make a change.

Company No. 9, which is using the one-ton rocker type cars in one of its mines, to facilitate loading and dumping, employs a one-ton end-dump car in other mines where the veins are smaller and the rock break fairly fine. This requires but one man to dump it and is considered desirable in small stopes where the ore cannot be drawn off so rapidly and where fewer men can work.

An Exception

Company No. 23, a Southern operator, has been using a side-dump car, but is retiring it in favor of special 60- and 90-cu.ft. end-dump cars, which are dumped by picking up the rear end with an air jack. Its experience is that this type of car, thus dumped, requires less maintenance, cleans itself better than side- or rocker-type cars, and because of its greater capacity, as compared with other types of the same dimensions, is most economically constructed.

Of the companies listed in Table II which are using bottom-dump cars, Nos. 18 and 22 have an ore that breaks fine and have each a car specially designed for their conditions. The remaining two are using cars of fairly large capacity.

Cars are being used for so-called intermediate haulage by only eighteen of the companies considered. Some of the remaining twelve have no "intermediate" stage of haulage and the others are using scrapers in place of cars. Of the 18 employing cars, all but four use the end-dump type in smaller capacities that range with the one exception from 15 to 40 cu.ft. One of the four use a one-ton rocker-dump car and the remaining three are using one- to four-ton gable-bottom cars. Tipples being rarely installed on intermediate levels, and absence of rigid box-type cars is not surprising.

The Popularity Vote

Consideration of the foregoing facts shows that, so far as this survey is revealing, the rigid box-type car leads in popularity to some extent for main haulage work, with the rocker dump car a good second. Whether or not the end-dump type or the gable-bottom car should be given third place for main haulage is hard to say. Certainly where the tonnage to be handled is large, the quicker dumping, self-cleaning, gable-bottom car should prove superior. However, it wastes considerable space. Moreover, the end-dump car has its peculiar advantages. Were the survey limited to operations of small size, the end-dump car might prove to be the most widely used. Where the ore breaks small and large capacity is desired, the bottom-dump car, especially of the type used by the companies listed in Table II, is employed to only a limited extent, although deserving of wider application.

Sizes to Please

Car capacity varies greatly as will be seen from the figures given in the tables. More uniformity as to the sizes

The big boss takes the chip-of-the-old-block to the toy shop to make a selection. Picking a car seems to have its difficulties.

carried in competing lines, and possibly some limitation as to the number, might be profitable to manufacturers. The variety and size reflect the desire of the manufacturer to give the customer anything he asks for and also are the result of the fact that some mining companies make part or all of their cars themselves, are therefore, more likely at times to produce unusual sizes.

As the length of haul increases, larger capacity of cars may become more desirable. Thus, with regards to No. 14, in Table II, a progressive mining company in the South is now using a 40-cu.ft. rigid-box type car. Increasing length of haul will soon force it to adopt a five-ton car of the same type, this operator says. The heavy-duty rigidly built car used is favored because of the rough and heavy muck produced by the mill-hole method used in mining at this property.

Larger capacity is favored also by Company No. 4, a large independent iron-ore operator of the Lake Superior region. This company is now using principally a 40- to 50-cu.ft. rocker-dump car for main haulage in its Minnesota mines, but is beginning to standardize on this type, and finds a 55- to 60-ft. car more suitable. In its Michigan mines, conditions vary so, however, that standardization on any particular size appears to be impracticable.

On the other hand, No. 7, a lead-silver ore producer having between 700 and 800 cars in service, is using a 20-cu.ft. end-dump car for intermediate haulage. Experience has taught it that a 16- to 18-cu.ft. car would be better suited to its needs, being more easily handled by one man.

Decision Difficult

In view of the rather widely varying preferences and practice evidenced in the foregoing, any effort to promote the adoption of some particular type or size of car within the metal mining industry would seem, at the outset, to run the risk of failure. Ability to standardize depends on the conditions that prevail. Throughout the industry conditions vary widely. However, an individual operator can standardize on one or two types of cars in most instances, this not necessarily meaning that he must scrap his present equipment to do so, but rather that he can make replacements with the standard types as they become necessary. By thus delaying the resort to scrapping, new expenditure is also delayed, although possibly at the risk of incurring some not easily calculated operating loss.

Three Types

Some approximation as to standards for the industry as a whole, moreover, may be found quite feasible, despite the maze of conditions that exist. Clearly, for main haulage work, the rigid box-type car and some form of side-dumping car should suffice to meet all requirements in new developments and most requirements in old. If further simplification be required, the rigid-box type could be eliminated on the ground that it requires an additional piece of equipment for dumping it, although this would sometimes mean a sacrifice, in view of the rapid handling of tonnage it permits. Rotary dumping possesses great advantages.

For intermediate haulage, in all except the very unusual mine, the end-dump car of small to medium size should be sufficient. Inasmuch as the haulage system in many small mines may be classed throughout as on a par with the intermediate haulage of larger mines, the end-dump car should be the only one required in them, as is often found actually to be the fact. This type of car lends itself readily to small-scale operation.

What Others Think

To some extent, these suggestions check with the recommendations made by the standardization division of the American Mining Congress, and approved by the American Engineering Standards Committee (now the American Standards Association) in 1928. These called for a 20-cu.ft. box-shaped end-dump car for hand tramming and a three-ton (or larger) side-dump car for motor haulage. A. H. H.

Digest of Current Literature

Geophysics. Compiled by Frederick W. Lee. Bureau of Mines Circular No. 6154, entitled "Geophysical Abstract No. 3." This is the third installment of this series of abstracts of literature on geophysical subjects, which the Bureau of Mines has undertaken to produce. All things considered, the publication of these abstracts constitutes a unique and valuable service.

Copper Converter Practice. Arthur J. Caddick. *Metal Industry*, July 19, 1929. For ascertaining the grade of matte to be produced in the furnaces for treatment in the converters numerous factors must be considered, and each case must be decided on its own merits, according to the prevailing conditions which will give lowest production costs. Investigations on this subject are reported which were made over a period of years in actual manufacturing practice. The major factors included in this study were: Relation of grade (copper content) of matte to general converter practice, amount of flux, quantity of cold material added, slag production, air compressor and converter time, air consumption, process losses, relation of grade of matte to time of blowing to white metal stage, and relation of tuyères in operation to blowing time. Figures are given, in tabulated form, on the conversion of some low-grade mattes (12, 14, and 20 per cent copper). Other tables show time losses during blows, converter temperatures, and analyses of mattes. Observed excess of air consumption over the theoretical requirement ranged from 33.4 to 72.2 per cent. The excess is the result of losses while punching tuyères and leakage through linings. The importance of keeping the tuyères in open working order is shown in the blowing time per ton of copper from matte. This time ranged from 66 minutes with 24 tuyères effective, to 207 minutes with only 8 tuyères effective.

Bauxite. R. J. Anderson. *The Mining Magazine*. July, 1929. The author deals with the bauxite deposits situated in the Cherepovetz government district of Tikhvin, Soviet Russia. The information given is based in part on reports by Russian geologists (Maliavkin, Volkov, Ansheles, Vasilievski, and others) and in part on examination and study of the deposits by the writer. Russia is poor in bauxite resources, so far as known. Although occurrences of the mineral have been reported in various localities, the only proved deposits of commercial value are those near Tikhvin, about 137 miles southeast of Leningrad. Detailed study of the field has been made almost uninterruptedly since 1921. The principal results of the work done up to the winter of 1928 are given by Mr. Anderson.

Induction Furnace. M. H. Kraemer. *Metall und Erz.* June, second number, 1929. The present trend in design and construction of induction furnaces for melting metals is toward the use of medium or low frequencies. There is another and quite independent trend, however, toward utilization of the highest practicable frequencies. The devices for stepping up the frequency include stationary transformers, electron-emitting tubes, and spark-drawing furnaces. One installation (at the Metallurgical Institute of the Technische Hochschule, Berlin) has an available frequency range from 20,000 to 200,000 hertz, derived from an ordinary 50-hertz alternating current. The melting of metals in the "open" type of induction furnace is characterized by the Pinch effect, which introduces new metallurgical possibilities and advantages, but which also has its disadvantages. It seems to have an assured cost advantage, but judgment even on this should be reserved till practical operating results are known. In any event, this type of furnace is not likely to replace any except the iron-sealed induction furnace, which had already lost much of its importance. The open induction furnace has widened the range of metallurgical possibilities, but as long as the eddy effect can be controlled only by cutting down the energy output, its use must be attended with some reserve of caution.

Russian Ore Exports. *Metall und Erz.* July, first number, 1929. A recent special report from Russia states that the decline in mineral exports in the last few years is the result, largely, of the great decrease in exportation of manganese ores. This was attributed in part to the unsatisfactory state of the manganese market, and partly to the termination, in 1928, of the Harriman concession. A government trust now operates the workings at Chiaturi, and is undertaking to improve the methods in use. Exportation of zinc concentrates has greatly increased, from less than a thousand tons in 1925-26 to 22,747 tons in 1927-28. This is to be credited largely to the operations of a British concession in the Tetiuhe district. Most of the zinc concentrate is shipped to Belgium. The pre-war status of Russia as a platinum producer has not by any means been regained. Competition from Colombia, Canada, and the United States, fostered during the period of high prices, is still very prejudicial to Russian production. In the last two years Russia has become an important exporter of chrome ore, chiefly to Germany and France. In view of the demand, the scattered Ural deposits are to be systematically worked for production of high-grade standard chrome concentrates. Recent increases are also noted in the shipment of ores of silver, lead, copper, and antimony.

Electrodeposition of Metals. F. Forester and K. Klemm. *Zeitschrift für Elektrochemie*, July, 1929. Electrolytic deposits of tin and cadmium may take a great variety of forms, much influenced by changes in electrolyte composition and other factors. The two general forms which are recognized are the clusters of needle-like crystals growing out from the cathode, and the finely crystalline deposit (in orderly or random arrangement) parallel to the surface of the cathode. The effect of sulphonated cresol in preventing the needle crystal growths has been investigated, and is attributed to impurities (unsulphonated cresol and resinous condensation products) in the cresol sulphonic acid. By adsorption of these impurities, in an acid stannous sulphate electrolyte, the tendency of the tin to form needle crystals is repressed. The repression is not observed in stannous chloride electrolyte. Cadmium is so much more sensitive than tin to the effect of the adsorbed impurities that a cresol sulphonic acid purified with animal charcoal still retains enough of the impurities to give an effect similar to that of the crude reagent on tin deposits. This statement applies to acid cadmium sulphate; in ammoniacal sulphate solution, in which the cadmium shows much greater tendency to needle growth, the effect of the purified cresol sulphonic acid is to increase the current density at which needle growth occurs. In acid chloride or perchlorate solution cadmium does not form the needle crystals, even at high current densities.

Lead Smelting. G. L. Oldright and Virgil Miller. *Serial 2954, Reports of Investigations, U. S. Bureau of Mines,* August, pp. 8. This paper describes a method for approximating the amount of lead present in slag and other products of the lead blast furnace and is the first of a series of five papers to be issued by the Bureau on lead blast-furnace smelting. Experimental work covered by this first paper deals largely with lead as the metal, the sulphide, or silicates, or with mixtures of these substances, inasmuch as these three forms were the only ones found to be present in the several hundred slags examined.

The method sponsored by the authors of the paper follows: Place a 0.5 to 5 gram sample reduced to minus 100 mesh in a 250-c.c. beaker, add 25 c.c. of a saturated solution of ammonium acetate, dilute to 100 c.c., and boil for 10 min.; filter solution through an asbestos mat in a Gooch crucible, and wash residue free from the solvent with hot distilled water. The filtrate contains whatever amount of lead was present as oxide, sulphate, or basic sulphate. The residue contains the lead present as sulphide, silicate and metal. (For slags the treatment with ammonium acetate may be omitted.) Transfer the residue or the weighted sample of slag to a beaker and evaporate until the residue is only slightly moist; then add 10 to 20 c.c. of a 10 per cent solution of silver nitrate. Treat for one hour in the cold, occasionally stirring with a rod to break up lumps. Filter through an asbestos mat in a Gooch crucible, and wash the residue free from silver nitrate. The filtrate contains the lead that was originally present in the metallic form, and the residue contains the lead present as sulphide and silicate. Transfer the residue to a 250-c.c. beaker, expel water as before, and add 25 to 50 c.c. of a saturated solution of sodium chloride containing 60 grams of ferric chloride salt per liter. Treat at from 25 to 28 deg. C. for twelve hours and agitate occasionally. Filter the solution through filter paper and wash the residue once with some of the original solvent; then wash free from soluble chlorides with hot water. The filtrate contains the lead originally present as sulphides, and the residue contains the lead present as silicates. Filtrates and residue are then analyzed by the standard methods to determine the lead content of each. From these data the percentages of the total lead content present originally in the oxidized form and as metallic lead, lead sulphide, and lead silicate may be calculated.

The subjects to be discussed in the four remaining papers of the series are: (1) Composition of the gases issuing from the top of the blast furnace; (2) accretions, their method of formation, analysis, and influence on smelting; (3) the gases obtaining in the tuyère zone and their effect on smelting; and (4) the effect of the gases of the tuyère zone on the loss of lead in slag and on the composition of the slag.

NEWS OF THE WEEK

Summary

PRODUCTION of the copper districts in southern Arizona—Bisbee, Ajo and Morenci—is now about 13,000 tons higher than at this time last year. Phelps Dodge and Calumet & Arizona are spending large sums on the improvement of their mines and metallurgical plants. A résumé of operations. Page 408.

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Outlook for more new gold-producing records on the Witwatersrand is still favorable. The disappearance of several of the old mines will probably be more than offset by the addition of three or four new large-scale operations. Page 405.

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Alaska Juneau and United Eastern have taken options on three promising properties in the new Taku silver-gold district of Alaska. Page 407.

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About 300 operators, technicians, and prospectors attended the mining revival at Prescott, Ariz. This was the third of a series of such revivals that have been held in the Apache State. Page 406.

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American Smelting & Refining has taken over operation of Tintic-Ophir Mining, in the Ophir district, of Utah, under contract. Page 406.

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Consolidated Mining & Smelting reopened its copper smelter and refinery at Trail, B. C., on Sept. 1. Concentrate and blister copper from Granby Consolidated will be treated. Page 406.

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Drilling at the Teziutlan unit of Mexican Corporation, in the State of Puebla, Mexico, has shown the existence of a new orebody below the 250-meter level. Development work at the Fresnillo unit also results favorably. Page 410.

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Operations have been started at the Waterval (Rustenburg) Platinum property, in western Transvaal. This is the first plant to produce platinum on an extensive scale in the district. Page 410.

Rhodesia Broken Hill Preparing to Increase Zinc Output to 1,500 Tons Monthly

By George L. Walker
Special London Correspondent

INCREASING of the supply of energy from Rhodesia Broken Hill's hydro-electric plant will make possible the treatment of a larger tonnage of ore at the company's electrolytic zinc plant in Northern Rhodesia. Expectations are that in January production will be at the rate of 1,500 tons of zinc monthly, as compared with 798 tons averaged in 1928. This property, which is the most important lead-zinc mine yet opened up in Africa, operated at a loss of £26,078 last year, instead of the expected large net profit.

The electrolytic zinc plant, specially designed by R. H. Stevens to deal with ores occurring in a dolomite formation and containing, besides zinc, lead, and silver, an important vanadium content, is in so many respects different from any other plant previously built that it required adjustment by a master hand. Just as it was ready to go into commission, however, Mr. Stevens became ill and was obliged to leave Rhodesia and remain away for many months. Because of his absence, the plant failed to come up to expectations.

Mr. Stevens is a specialist of wide experience. Before going to Rhodesia he had designed the highly successful plant of the Electrolytic Zinc Company of Australia, at Risdon, Tasmania. He had included several new ideas in the plant at Rhodesia Broken Hill, patents being taken out on some of these.

At first there appeared to be an insufficient supply of sulphuric acid, the recovery being only 1.86 tons of zinc per ton of acid consumed. To overcome this deficiency an extension of the sulphuric acid plant was started and will soon be completed. Since Mr. Stevens' return, the recovery has risen to three tons of zinc per ton of acid consumption. However, the larger acid making capacity will be needed when the output is increased.

The future policy of the company, as outlined by Sir Edmund Davis, chairman, at the annual meeting, is to improve the zinc output, then to deal with lead production, and thereafter complete the plant for the production of vanadium. As considerable expenditures will be necessary, the large interests in the company, will, according to report, lend it £250,000 for two years at 1 per cent above the bank rate, no interest being charged till after June 30 next.

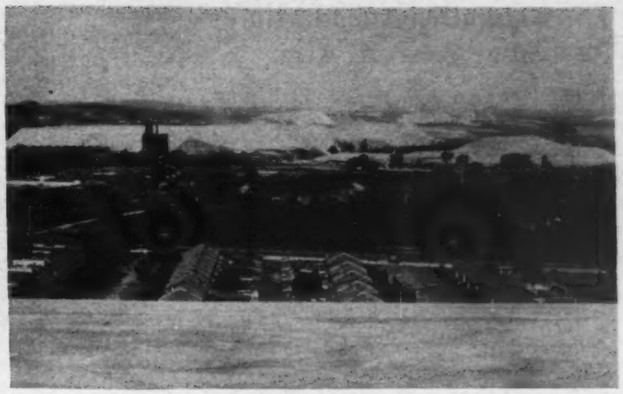
Lead production last year was 4,676 tons. To increase this figure, the lead orebodies were drilled with favorable results. Little lead oxide ore is left on the property, but immense tonnages of zinc silicates, containing some lead, await treatment in the electrolytic zinc plant. The lead sulphide ores are hereafter to receive more attention.

Sir Edmund Davis, who directs the affairs of Rhodesia Broken Hill and of many other companies, always seems to find a way to remove obstacles from the paths of his enterprises, to find the necessary capital, and to develop earning power. About a year ago someone expressed the opinion that Mulungushi could not be made to supply sufficient electric energy for Rhodesia Broken Hill's requirements, so other sources of power were investigated. Sir Edmund refused to believe that more power could not be developed at Mulungushi, however. Recent investigations have demonstrated that all the company's needs can be provided from that source with only a small additional expenditure for plant and canal.

In the meantime the company found important water power available on the Lunsemfwa River and began preparation for its development. Recently some of the copper companies have arranged to take over the Lunsemfwa site, compensating Rhodesia Broken Hill, and to develop it on a large scale. They are also said to be negotiating for the purchase of Rhodesia Broken Hill's Mulungushi installation.

Sunshine to Make Another Increase in Mill Capacity

Sunshine Mining is building an addition to its mill in the Coeur d'Alene district of Idaho, which will permit raising capacity from 200 to 350 tons daily. Within the last three months the capacity has been increased from 125 to 200 tons. At the mine, the incline shaft is being raised from the 500 level to the Price tunnel level. This will permit handling ore from below the 500 level in one lift. Ore has been proved for 275 ft., over a width of 16 ft. in the Yankee Boy vein at the 500 level, in addition to 1,300 ft. of ore in the Polaris vein which has already been proved.



Johannesburg, as seen from the Ferreira mine, is shown on the left and at the right is a typical view along the main reef, looking east

Developments on Far East Rand Outweigh Exhaustion of Old Mines

East Geduld, Daggafontein, and Witpoort, Now Sinking Shafts, Will Have Eventual Output of Over 2,000,000 Tons Yearly —Grootvlei Another Potential Large Producer

By Owen Letcher
Special Johannesburg Correspondent

BIG DEVELOPMENT at three Far East Rand mines—East Geduld, Daggafontein, and Witpoort Gold Areas —is now in progress, and if these can reach production before many of the older mines work out their claim areas. gold output of the Witwatersrand district should continue to achieve records for a good many years. This year a record is expected, despite the suspension or impending exhaustion of such old outcrop mines as the Wolhuter, Ferreira, Meyer & Charlton, and New Primrose. In the course of time, the three East Rand properties mentioned should be milling at the yearly rate of approximately 2,250,000 tons of ore—which will effectively compensate for the disappearance of several small-scale producers.

The announcement that the directors of East Geduld Mines, Ltd., had decided to proceed with the sinking of its first shaft was made only in the middle of April, but the vertical portion of the new headframe is already approaching completion. The first steam sinking hoist is partly erected and construction of the boiler house has made good progress. A Babcock & Wilcox boiler has been erected. The initial sinking work has been expedited by means of machine drills, two portable Ingersoll-Rand compressors being installed next to the collar of the shaft for supplying air.

Anticipated depth of the East Geduld No. 1 shaft is 3,250 ft. The shaft is of five compartments, with 8x5 ft. 8 in. clear between timbers in each compartment, making the average cross-section of the excavation 34x10 ft. 6 in. Sinking, beginning in September, will be in charge of Mr. Boyd, who sank the Betty shaft for Sub Nigel and set up a record for speed there.

At Daggafontein No. 3 shaft the plant and sinking equipment have arrived. The new shaft is rectangular, with five compartments, each measuring 9x6 ft. inside the timbers, making the nominal dimensions of the excavations 35 ft. 6 in. by 11 ft. 6 in. Its estimated depth is 4,000 ft. The reef horizon is expected to be reached by the end of 1930. Sinking operations at this shaft will be in charge of Mr. de Jager, who was in charge of sinking at the No. 4 shaft of Springs Mines.

At Witpoort Gold Areas the old Rand Collieries shafts are being bailed. The water stands at about 150 ft. above the station on the No. 7 level, at which point the main shaft intersects the reef horizon. The heaviest stage of the unwatering process is now under way. The operators expect that the shaft bottom, some 200 ft. below No. 7 level, will be reached soon.

Besides these three there is another huge potential gold producer in Grootvlei, which adjoins East Geduld on the east. This property is under the control of the Lewis & Marks group, and the owners are awaiting the results of further development at East Geduld before formulating an exploratory program.

Start Deepening Shaft at East Tintic Coalition

SINKING of the East Tintic Coalition shaft has been started by Standard Lily Extension near Eureka, Utah. Through a co-operative agreement with International Smelting, which controls East Tintic Coalition, Standard Lily Extension gets a permanent entry to its Addie and other claims, totaling 90 acres, for sharing the expense of sinking the East Tintic Coalition shaft. The shaft is now about 375 ft. deep. George Sylvester, contractor, is doing the work.

The shaft will be continued to the Cambrian limestone, about 2,000 ft. below the present level. Standard Lily Extension has installed a Seaver-Williams electric hoist, capable of operating from 1,500 ft.; a Sullivan angle-compound compressor; and three 50-kva. transformers.

Develop Area Near Park City

Exploration of the Park City formation will be started at once at Kamas, Utah, 15 miles east of Park City. Two companies, Kamas Gold, and Beaver Creek Gold & Silver, will begin work under the direction of Newton Dunyon. Development will be initiated in an area across which a projection of the Park City fissure zone falls in ground showing mineralization and possessing a vein system with the same strike and dip as that considered the main mineralizing channel in Park City.

Manitoba Companies Award Construction Contracts

CONSTRUCTION contracts for work at Manitoba's two most important developing mines, the Flin Flon and the Sherritt-Gordon, have been awarded recently. Hudson Bay Mining & Smelting, operating the Flin Flon mine, will have fire-proof material for the headframe, ore bins, hoist house, and coarse-crushing plants supplied by Western Steel Products, Inc., which will also do the construction work. Good progress is being made in erecting the structural steel for these buildings. The work of inclosing them will be started early this month.

Manitoba Bridge & Iron Works will supply the materials for and build the headframe ore bins work shop and change house at Sherritt-Gordon.

Three Hundred Attend Mining Revival at Prescott, Ariz.

MORE than 300 mining men, prospectors, and mining corporation executives assembled in Prescott, Yavapai County, Ariz., on Aug. 24 when the third of a series of mining revivals in Arizona was opened in that historic city. The first of the series of revivals was held in Yuma and the second in Nogales. Probably the outstanding result of the meeting was the declaration of large mining companies that their technical staffs and research laboratories would be placed at the disposal of the small prospectors and developers in the state. Two speakers who emphasized this were Michael Curley, manager of New Cornelia Copper, at Ajo, and W. V. DeCamp, general mine superintendent of the United Verde Copper Company, Jerome.

Other speakers included: J. B. Tenney, geologist of the University of Arizona, who spoke on "Service the University of Arizona Renders to the Prospector and Mine Developer"; Charles Wright, of the U. S. Bureau of Mines, who discussed "What the Bureau of Mines Is Doing and Contemplates Doing"; Howard S. Fields, ore-purchasing agent of American Smelting & Refining at El Paso, "Valuation of Prospects"; and Mayer G. Hansen, chief geologist, United Verde Copper, "Non-Metallics of Yavapai County."

Under the general heading of "Successful Application of Engineering Principles to the Prospect," R. H. Dickson discussed "The Cost of Bringing a Property Into Production (the Verde Central)," and H. L. Tedrow told about "Mechanically Equipping a Property (the Sheldon)." Under the general topic, "Necessity of Competent Experiment and Research in Treatment of Ores Prior to Production," Charles T. Baroch discussed the metallurgical work at the Bagdad mine; E. L. Swinney described the carbonate ores at the Zonia mine; Jack English told of "Leaching at the United Verde Extension"; and Charles Kuzell spoke on "Making Ore Out of Waste" at the United Verde. O. E. Glaeser, ventilation and safety engineer at United Verde, and Roy Marks, safety engineer at United Verde Extension, gave demonstrations of first aid, mine rescue work, safety practice and safety equipment. J. J. Jakosky, of the Radiore Company, of Los Angeles, explained the various methods used in geophysical prospecting.

Resolutions were adopted at the revival asking that the State of Arizona provide additional financial support for work of the Arizona Bureau of Mines and requesting Arizona members of Congress to seek legislation modifying or clarifying the federal laws covering mineral claims in cases of disseminated orebodies.

To Ed McGinley, 101 years old, resident of the Pioneers' home, who claimed to be the oldest prospector living, a loving cup containing $101 was presented. When a call was made for prospectors over 50 years of age to stand, a group of 25 grizzled pioneers responded to the request, indicating that the individual prospector who essays work on his own small capital is still in Arizona.

W. J. Graham, of Phoenix, was appointed chairman of a committee to organize small operators for gathering statistics to present before the Interstate Commerce Commission in opposition to an increase in freight rates on ore and mine products. George G. Thomas, general manager of Bagdad Copper, served as chairman of the committee in charge of the mining revival.

Agencies co-operating in the staging of the revival included the Yavapai County Chamber of Commerce, the Arizona Industrial Congress, the Arizona chapter of the American Mining Congress, and the Arizona section of the A.I.M.E.

A. S. & R. to Work Ophir Claims Under Contract

OPERATIONS of American Smelting & Refining have been extended to the Ophir district of Utah, where work has been started an a long-term operating contract in the holdings of Tintic-Ophir Mines, including some of the oldest claims in Utah. Development will be started at the old Chloride Point, where the first location and first mining were done by General Connor, Union commander, in 1871. Development will be done on a contract basis, according to A. H. Means, manager of the Western mining department of A. S. & R.

Raising will be started to reach the Humbug limestones from the Buffalo Con. tunnel. Production has come from the top member except in the Buffalo Con. property, which is also included in the arrangement. There, the second bed has been developed and some good ore mined. Systematic exploration of the lower beds is believed to have a good chance to bring in new ore. At least 1,500 ft. below the upper limestone series lies the Ophir limestone horizon from which production has come in the Ophir Hill mine of the late Senator W. A. Clark, across from Lion Hill on the north side of Ophir Canyon.

A crosscut from the Buffalo tunnel will also be run a distance of 300 ft. to explore the Gladstone fissure.

Alamita to Work Area Adjoining Presidio Mine

Development of 23 claims totaling 463 acres, adjacent to the Presidio silver mine of American Metal at Shafter, Tex., will be started immediately by Alamita Mining. The company will install a 50-ton concentrating plant. Officers of Alamita Mining are W. J. Hurd, of San Angelo, Tex., president, and R. E. Beaman, of San Angelo, vice-president and treasurer. The extension which the Atchison, Topeka & Santa Fe Railroad is preparing to construct from Alpine to Presidio will pass within about a mile of Shafter, thus doing away with the present 60-mile haul by truck to Marfa, the nearest railroad point.

Cresson to Build Tramway

Cresson Consolidated, operating properties in the Cripple Creek district of Colorado, is planning construction of a tramway from its ore bins to the loading station at Eclipse. This will permit loading ore from the mine dump, which is estimated to contain 250,000 tons, by steam shovel. Shipment will be to the Golden Cycle mill, at Colorado Springs.

Trail Copper Refinery Reopened on Sept. 1

CONSOLIDATED Mining & Smelting reopened its copper refinery at Trail, B. C., on Sept. 1, after a shutdown of about ten months. Blister copper from the Anyox smelter of Granby Consolidated is being shipped to the refinery. Concentrate from the same company's Allenby mill is also reported to be on the road to Trail, where it will be smelted and refined.

No statement has been made concerning rates for treatment, which were sources of contention between C. M. & S. and Granby. However, West Kootenay Power & Light, subsidiary of the smelting company, has filed a statement with the Provincial Water Board of British Columbia that a flat rate of 0.85c. per kilowatt-hour will be charged Granby, instead of 0.65c. to 1.05c., depending on the market price of copper.

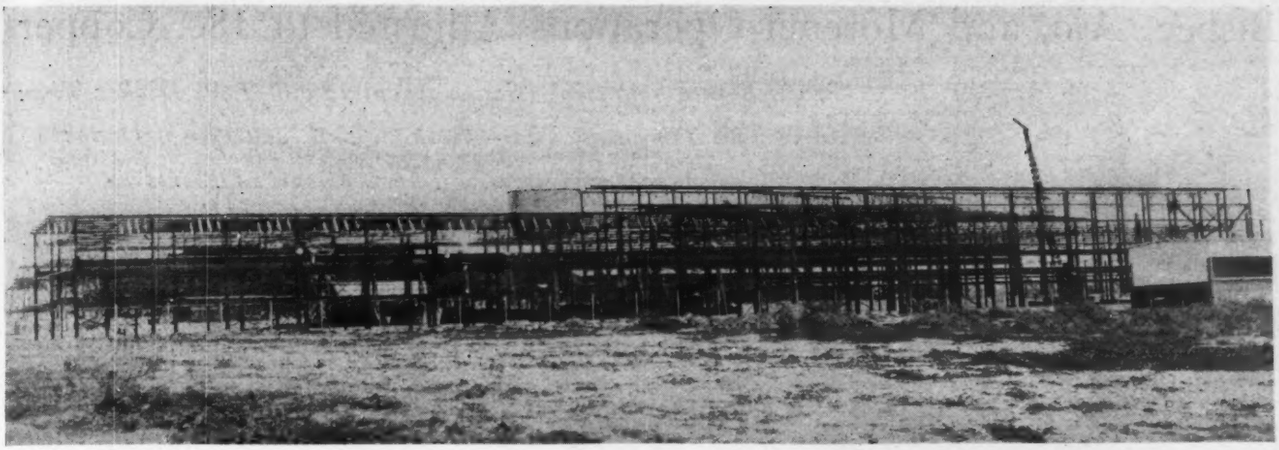
Golden Cycle Adding Complex-Ore Unit to Plant

Construction of an additional 200-ton unit, to handle complex ores containing copper, lead, silver and zinc, is now under way at the Golden Cycle Mining & Reduction plant, at Colorado Springs, Colo. The new unit will be in operation by Oct. 1, according to L. S. Harner, manager. "Sub A" Fahrenwald flotation machines will be installed. Concentrates will be shipped to smelters and tailing will be cyanided to recover the precious-metal content.

Golden Cycle has hitherto treated gold ores exclusively at its plant, which has a capacity of about 800 tons daily. Practically the entire output of the Cripple Creek district is treated there.

New Tom Reed Ore High Grade

Drifting on the new discovery at the 950 level of the Tom Reed mine, in the Oatman district of Arizona, has proved ore for 300 ft. Average width is from 6 to 8 ft. This orebody was first struck about two months ago, in sinking to the 950 level. Its grade is said to be high, particularly in the east face. Milling has not yet started.



Steel Work Finished at New Nichols Refinery

Steel work has been completed on the main building of the new Nichols Copper refinery, being built at El Paso, Tex. There will be about twenty buildings in all at the plant, according to B. H. Gerwin, local business manager of the company. The refinery will be the first built in the Southwest, although there are seven already in operation in other parts of the United States. Capacity will be 100,000 tons of blister yearly. Most of the material treated will come from Phelps Dodge and Calumet & Arizona. Both of these companies are financially interested in the plant. The illustration herewith shows one wing of the new refinery in mid-August.

Alaska Juneau, United Eastern, Expand in Taku River District

ALASKA JUNEAU has acquired a new prospect in the district about the Taku and Tulsequah rivers, in British Columbia, according to James B. Stapler, general superintendent for United Eastern Mining, of Los Angeles, who was in Victoria recently on behalf of his own and the adjoining Alaska Juneau company. Mr. Stapler urged the Minister of Mines to construct a trail to open up the district so that it may be reached from the Pacific by way of Taku Inlet, near Juneau.

Alaska Juneau's new prospect consists of a 55 per cent interest in a property on the Tulsequah River. A prospector named Valentine, who made the discovery, will receive $25,000 at once, and the same amount in six and twelve months. The company will develop the property and bring it to production. Work will be started as soon as supplies can be sent to the property and will be continued through the winter. The discovery was made on the side of a creek. It was stripped along the bank for 30 ft., and then the surface was sluiced off from a point higher up. The ore carries gold and silver and is heavily mineralized with pyrite and some galena, sphalerite, and chalcopyrite.

Alaska Juneau has also taken an option on the Big Bull property, on the Taku River just above the Tulsequah branch. I. Goldstein, of Juneau, and his associates backed a prospector, M. V. Manville, who discovered the property last May. The surface was stripped and an orebody exposed for about 800 ft., the width varying from a few feet up to 30 ft. Sampling showed low-grade gold and silver and good quantities of zinc, lead, and copper. Supplies and a gasoline hoist, together with accessory equipment, have been sent to the property. Present plans provide for starting an adit level and sinking a shaft on the hill above.

United Eastern has about 50 men developing a similar deposit in the same district. It acquired an option on the prospect in the spring, and has done nearly 500 ft. of tunneling and drifting and some diamond drilling and stripping on a body of well-mineralized ore, 25 ft. wide and of good grade in gold and silver. Mr. Stapler is enthusiastic about the possibilities of the district. About 400 claims have been staked, chiefly by Juneau residents.

Russia Plans Modernization of Its Asbestos Industry

Modernization of the mining and milling methods now used in the Russian asbestos industry is planned. Walter A. RuKeyser, consulting mining engineer, of New York, is now on his way to the Ural Mountains, where the principal deposits are situated. He will lay out new development work and design new plants. Last autumn Mr. RuKeyser made the preliminary plans for a 3,000-ton asbestos plant for the Uralasbest. Mr. RuKeyser and A. R. Martin recently disposed of asbestos holdings in the Danville district of Quebec. This property is known as the Nicolet property. The new owners are erecting treatment plants.

Silver Dyke Closed Down

Silver Dyke Mining, subsidiary of American Zinc, Lead & Smelting, operating since 1923 at Neihart, Mont., has closed down. The complex silver-lead-copper ore afforded a difficult ore-dressing problem, which was in a fair way of solution when mining difficulties developed. Glory-hole mining was practiced in the last few years. The original ore reserves were depleted during the period of experimentation, and as no further deposits were found after intensive prospecting, the operation had to be abandoned.

Quartz Hill Central, Long Flooded, Reopened

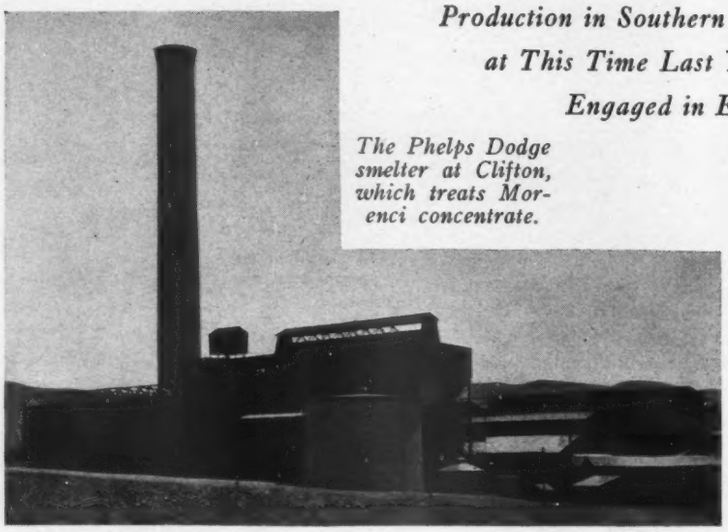
AFTER having been under water for over 30 years, the property of Quartz Hill Central Mining, at Central City, Gilpin County, Colo., has been successfully reopened down to the bottom of the old shaft, a depth of 800 ft. Ore from the 700 level is being shipped to the Argo mill, at Idaho Springs. On this level a shoot of high-grade complex gold-copper ore, 150 ft. long and 4 to 6 ft. wide, has been developed, according to Charles Gage, president of the company. Beginning 200 ft. to the west of this there is reported to be another shoot, 500 ft. long, developed by old-time operators. Under old milling methods this was junore, but it should be amenable to the selective flotation process in use at the Argo mill.

Belcher Extension Will Drill

Diamond drilling will be the next step in the exploratory development of the Fortuna property, in the Superior district of Arizona, which Belcher Extension Consolidated Mines holds under a ten-year lease from Fortuna Consolidated Mines. This decision was reached after a geophysical exploration of the property was completed by the Radiore Company, which showed strong indications of mineralization along a fractured zone at a depth of about 400 ft.

Bisbee, Ajo, and Morenci Operations Adjusted to 18c. Copper

Production in Southern Arizona About 13,000 Tons Higher Than at This Time Last Year—Both C. & A. and Phelps Dodge Engaged in Extensive Improvements of Plants



The Phelps Dodge smelter at Clifton, which treats Morenci concentrate.

WITH the price of copper stabilized at 18c. a pound for the last four and a half months, operations of the big producers in southern Arizona have gradually become adjusted to the new level, which is in sharp contrast with the average of about 14c. a pound that copper mines obtained for their product from 1921 until last fall. Monthly production at Bisbee, Ajo, and Morenci is running slightly below the peak attained earlier in the year. The decline may be attributed to the usual summer slack and to the decision of most of the large copper producers to decrease their output about 10 per cent, until the consuming demand that caused the first tremendous increase in output reappears in the market. However, from published statements of Phelps Dodge and Calumet & Arizona, that output for the year will be considerably higher in 1929 than in 1928 appears certain. Already production of copper is higher by about 13,000 tons.

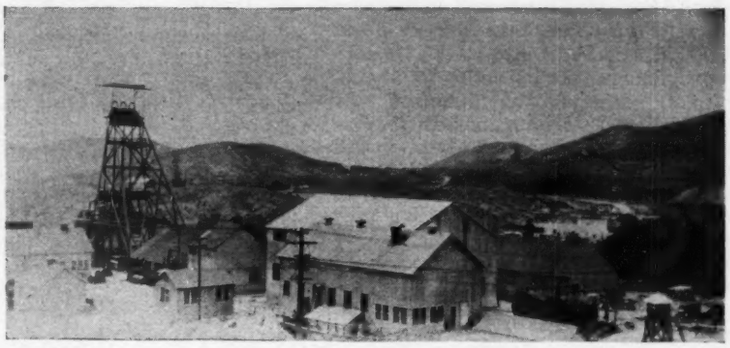
The merger of Calumet & Arizona and New Cornelia, consummated last spring, has put the entire copper output of the region, with the single exception of Shattuck Denn, directly in the control of two companies. Inasmuch as New Cornelia's leaching plant will soon be dismantled, and all ore produced at the mine will be concentrated and then shipped to the C. & A. smelter at Douglas, the merger offers obvious advantages to both companies. Both C. & A. and Phelps Dodge are now engaged in modernizing and re-equipping their mines and metallurgical plants.

On Aug. 15, the last steam shovel was moved out of the famous Sacramento pit of the Copper Queen branch of Phelps Dodge at Bisbee. In the twelve years that shovels have been operating on Sacramento Hill, the peak has been reduced 605 ft. below its original level. About 32,500,000 tons of material has been removed from the hill, of which about 20,000,000 tons was waste. Seven 4-cu.yd. shovels, 15 locomotives, and 75 40-ton side-dump cars were used in the operations. Ore still remains in the pit, but it will be removed by glory-hole mining. A new level has been driven for this work from the Sacramento shaft at the 500 level. Two new skips have been put in the Sacramento shaft to handle the increased tonnage that will result. The 130,000-cu.ft. blower formerly used for ventilation on the Sacramento 1,600 level has been placed on the 1,800 level.

At the Warren shaft, sunk in 1927 to explore Phelps Dodge ground in the area where Calumet & Arizona found its new Campbell orebody, no ore has yet been encountered, although some interesting mineralization has been passed through. However, lateral work has not yet reached its objective. Some diamond drilling is being done from the surface in this area also. Lead production is coming from the Southwest division.

No important changes have been made at the Warren concentrator, although experimental work is being carried on continuously and extraction has materially improved. The smelter at Douglas is being improved by the expenditure of about $1,000,000. An anode-casting plant is being installed which will ship anodes to the new Nichols Copper refinery at El Paso, Tex. Shipment of copper in the form of anodes, instead of the usual blister bars, will save melting and casting at the refinery. A new crushing plant, which will crush much finer than is possible with present equipment, is also being installed, as well as a new bedding and sampling plant. Also plans now provide for cooling the gases passing through the Cottrell system, to increase its capacity.

Calumet & Arizona is preparing to mine from greater depths at its mines in Bisbee. The Campbell shaft is being equipped to hoist ore from a depth of 3,600 ft. with a new Allis-Chalmers hoist that can raise 5½ tons at a speed of 2,000 ft. per minute. This company previously hoisted its entire output through the Junction shaft, but its operating officials now believe that the Campbell shaft can handle production from the new high-grade Campbell orebody more economically. For the present, the Campbell unit is being deepened to 2,500 ft. At the Junction shaft, an electric hoist with a capacity of 4,500 ft. will be installed. Auxiliary equipment will also be installed, including two new air compressors with a total capacity of 8,800 cu.ft. and a new power unit consisting of two 750-hp. boilers and a steam turbine, with cooling towers.



New steel headframe at the Denn mine of Shattuck Denn Mining

In addition to the installations mentioned, C. & A. is also spending a large sum in modernizing and enlarging its Douglas smelter, which will soon have to handle the increased output of concentrate from the New Cornelia mine of the company as well as the high-grade production from the Campbell orebody. An entirely new reverberatory unit will be installed, and the power plant will be enlarged. In all, Calumet & Arizona is spending about $6,000,000

for improvements at Bisbee, Douglas, and Ajo. The company's production at present is only about 5,000 tons of copper monthly, which is less than the average for last year, although total production for the year is running ahead of last year's total for the same period.

Shattuck Denn is the only Bisbee producer that is markedly increasing output. This company estimates its August production at about 1,400,000 lb. of copper, which is the highest for any month since the company was formed, in 1925. In June, the next highest month for the year, the company produced about 1,000,000 lb. Output is expected to show further increases each month for the rest of the year. The Denn mine is now hoisting about 500 tons daily from the new orebody on the 2,000 level. Developments immediately south of the shaft on the 2,200 level are reported to be favorable. The company has already opened up the orebody on this level, about 800 ft. west of the shaft, near the Calumet & Arizona boundary. The workings of the two companies have been connected to provide drainage for the Denn mine. A new hoist is in operation at the Denn shaft with a total capacity for hoisting 700 tons daily, and output will probably be increased to this point as new stopes are opened up.

The company's Shattuck mine is providing only a small tonnage of ore, its production in August having been only about 125,000 lb. Mining of lead ore from this unit has been suspended entirely.

At Ajo the end of the New Cornelia leaching plant, which handled the entire output of the mine when operations were started in 1917, and which was the pioneer installation of its kind in Arizona, is in sight, as reserves of oxide ore are now hardly sufficient for one year of operation. The concentrator, built in 1924 to treat 5,000 tons of sulphide ore daily, is being enlarged. In actual practice the plant proved able to handle 7,500 tons and, by the addition of new equipment, this has been raised to 10,000 tons. Three additional units are now under construction, which will further raise the capacity of the plant to about 16,000 tons. Three new shovels have been purchased for the open-pit operations, from which New Cornelia has produced all its ore to date. An additional 7,500-kw. turbine is being added to the power plant.

Development work at the mine which has been carried on for the last two and a half years has shown the existence of ore at a depth which would make open-pit operations impracticable. New Cornelia will probably, therefore, become an underground operation eventually, but this change is not likely to occur for many years. Last spring, New Cornelia's ore reserves were calculated at about 1,000,000 tons of oxide ore, averaging 1.31 per cent copper, and 113,250,000 tons of oxide ore, averaging 1.25 per cent copper. This is equivalent to about 30 years of operation at the present rate.

At the Morenci branch of Phelps Dodge, ore above the No. 4 level will soon be exhausted and undercutting operations will be changed to the No. 9 level. The No. 6 shaft, through which all hoisting will be done, is being deepened to the No. 18 level, to connect with the new drainage tunnel, completed in June. A new hoist will be installed about Dec. 1, when the connection is expected to be complete. Ore will be hoisted in seven-ton skips from the No. 14 level, which will be the main haulage level, replacing No. 6 level. The Joy shaft, through which men and supplies will be handled, is being equipped with a new elevator hoist.

Concentrator capacity at Morenci has been increased from 4,200 to 5,000 tons daily by the installation of two new 7-ft. Symons cone crushers and three 8½x12-ft. Vulcan mills, equipped with 300-hp. General Electric motors. A new Nordberg Diesel engine has been added to the power-plant equipment. No particularly important changes have been made at the Clifton smelter, which treats the concentrate production of Morenci.

Ore reserves at Morenci were estimated at 111,211,800 tons of 1.44 per cent copper on Jan. 1, as compared with only 20,657,241 tons of 1.86 per cent copper at Copper Queen. Consequently, this branch of the Phelps Dodge Corporation probably will gradually become the most important unit in the company's operations, a position that Copper Queen has occupied for many years. Last year, the latter branch produced about 115,000,000 lb. of copper, as compared with Morenci's output of 54,000,000 lb.

The Pacific mill, in the American Fork district, Utah .

Mudd Memorial Fund Reaches $200,000

UNDER suitable legal safeguards, $100,000 has been placed in charge of the A.I.M.E., by the family of the late Colonel Seeley W. Mudd, the income from which will be devoted to research and other activities for the benefit of the mining profession. The sum annually available, with that from the Rocky Mountain fund, will enable the board of directors to take up a portion, at least, of the problems now untouched. An endowment of $1,000,000 is needed. Under the chairmanship of J. V. W. Reynders, one-fifth of that has now become available. It is hoped, states H. Foster Bain, secretary, that others may be induced to join in the effort to place the Institute in a position to undertake the program which it should be able to meet in an adequate and effective manner, and without undue demand upon its current income.

Pacific Enlarges and Improves Old Concentrator

WITH the greatest activity in years in the American Fork district, 50 miles southeast of Salt Lake City, in the Wasatch range, Pacific Mining has been encouraged to enlarge its milling plant. The old gravity concentration plant has been rebuilt and a Fagergren flotation cell installed. Recoveries are said to be about 96 per cent, the concentrate averaging 60 per cent lead and 28 to 30 oz. silver per ton. Production of the Pacific is coming from the Cambrian quartzite formation, where a good tonnage of ore of milling grade has been developed.

At the Globe property, in Mary Ellen Gulch, in the same district, a winze has been sunk in the Yankee tunnel and drifting has been started into Globe ground to find the faulted segment of the Reade and Benson orebodies. Yankee Mines, adjoining the Globe, has exposed a good grade of copper-gold ore in these bodies, in limestone formation.

Manganese Men to Convene

On Sept. 9 and 10 the second annual convention of the American Manganese Producers' Association will be held at the Mayflower Hotel, Washington, D. C. James W. Gerard, Colonel George W. Steele, Senator Henry F. Ashurst, R. H. Brown, and A. J. Seligman will preside over the several technical sessions and social gatherings.

Johannesburg Letter

By Owen Letcher
Special Correspondent

First Platinum Plant Starts in Rustenburg Area—New Coal Found in Rhodesia

Johannesburg, July 31, 1929.—The Rustenburg district, in the western Transvaal, has commenced platinum production on an extensive scale. The pioneer producer here is Waterval (Rustenburg) Platinum, Ltd., which is under the technical control of New Consolidated Gold Fields. On July 24 Dr. Hans Pirow, government mining engineer, set the reduction plant in operation. Work was first started in 1928, and the reduction plant was completed and preliminary crushing begun exactly a year after A. A. English, mine manager, arrived to open operations. Today from 70 to 80 Europeans and about 600 colored workers are employed on the mine, and a village with offices, living quarters, a recreation hall, a football ground, and even vegetable gardens has grown up from the bare veld. Over £100,000 has been spent.

THE orebody is a norite. It was originally intended to work the sulphide zone, as no method was available for treating the more attractive oxidized ore. A method was evolved, however, by Andrew King, consulting metallurgist of New Consolidated Gold Fields, at an experimental plant erected at the Robinson Deep mine, which enabled Waterval Platinum to proceed with working the oxide deposits. Earlier production, cheaper plant, lower working cost, and winning of a concentrate that can be shipped in a readily realizable form are the results. If Waterval becomes the first commercially successful platinum producer in South Africa, it will be a turning point in the industry, said Dr. Pirow at the ceremonies on the opening of the plant.

Five miles from Waterval Potgietersrust Platinum is engaged on the erection of a plant that will treat 6,000 tons per month, and which is expected to come into operation in November.

A few weeks ago it was announced that coal had been discovered near the middle Kafue River in Northern Rhodesia. Considerable interest is attached to this region, containing as it does the Silver King, North Star, Hippo, Wonder Rocks, and other copper mines which figured prominently some years ago.

The location of coal of good quality in this area would have a most important influence on Northern Rhodesia and adjacent territories. Near here is the northern starting point of the proposed Kafue-Sinoia cut-off, which would reduce the distance between the center of the N'Dola copper fields and Beira by 500 miles. A potent argument against construction of this line has been that the Wankie coal field is a most critical point in the whole Rhodesian Railway system. To put in a new line which would largely eliminate Wankie would be a profitless policy; but if coal of good quality be found at the northern terminal of the suggested cut-off, the position will obviously be altered.

Mexico City Letter

By W. L. Vail
Special Correspondent

Drilling at Teziutlan Unit of Mexican Corporation Opens Up New Ore

Mexico City, Aug. 31, 1929.—Results of diamond drilling at the Teziutlan unit of the Mexican Corporation, in the State of Puebla, have continued very encouraging and indicate the existence of a substantial orebody below 250 meters. Holes now in the process of drilling will do much toward defining the relative importance of this discovery. About 200 tons of sulphide copper ore is being treated daily, and the value of concentrate produced is about $250,000 quarterly. At its Fresnillo unit, development on the 425-meter level of the Cueva Santa vein is showing a good grade of ore over a width of about 3 ft. The oreshoot has been opened up for 594 ft., averaging 13.6 per cent zinc, 11.7 per cent lead, 13.9 oz. of silver and 0.3 dwt. of gold to the ton. A raise has been driven from this level and has connected with the General shaft below the 340-meter level. Sinking of the Saraos shaft to 425 meters has been completed and skip-loading equipment has been installed. About 3,000 tons of ore is being treated daily, of which 2,500 is oxide.

OPERATIONS at Pittsburg-Vetagrande, at El Bote, Zacatecas, are at the rate of about 500 tons of silver-gold ore daily from its Vetagrande unit. Several new discoveries have been reported at this property. Canam Metals has been active in the vicinity. Under the direction of J. C. Archbold the old San Barnabe mine has been unwatered and exploration is also under way at the San Roberto and Panochia properties. The entire district will be benefited if Electric Bond & Share goes through with its plans for constructing power lines to the district, as is expected.

As for the new labor law, on which discussion will start when the new session of Congress meets tomorrow: Several industrial concerns have published statements regarding the possible effect that the law will have on their operations if it is passed. The Ford Motor Company is said to have abandoned its program of expansion in Mexico and General Electric has postponed its plans for construction of additional plants in Monterey. Mexican Light & Power estimates an annual additional expense of $1,500,000 and the National Railways, it is said, would have to increase rates 34 per cent to make a profit under the proposed law.

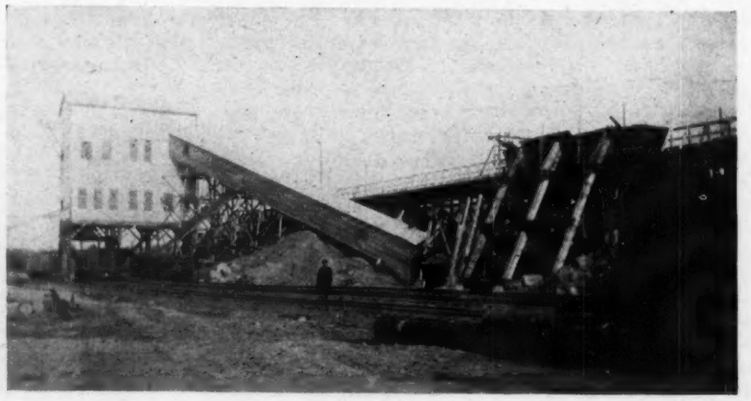
Margaret Mine Installs Washing and Crushing Plant

THE new washing, crushing, and screening plant of the Margaret mine, near Buhl, Minn., has been put in operation and is now shipping 1,000 tons of ore daily. The new installation beneficiates the rather low-grade hematite ore sufficiently so that the mine, owned by Butler Brothers, may join the ranks of the steady shippers of the Mesabi range. Iron content of the ore is increased from 55 to 58 per cent and silica content is reduced from 15 to 11 per cent.

Construction of the plant is of wood. Ore is dumped from cars into a pocket with grizzly bars which pass pieces smaller than 6 in. onto a 30-in. belt conveyor, and thence to the washer. The large pieces are crushed in a 3x3-ft. jaw crusher, driven by a 100-hp. Allis-Chalmers motor.

At the top of the washer structure the ore drops into a 6x16-ft. revolving screen of ¼-in. mesh. Oversize, after washing, passes directly to the shipping pocket. The undersize is chuted into a 30-ft. Dorr classifier, with 6-ft.-wide rake section. Sand is removed, and the fine ore raked up and discharged into the shipping pocket.

The new plant of the Margaret mine, Buhl, Minn.



MARKET AND FINANCIAL NEWS

German Metal Imports Smaller

Arrivals of Copper Ore Show Marked Increase in Recent Years—Zinc Operations Up

By Dr. James Rubinfield
Special Berlin Correspondent

EUROPEAN metal markets have been marking time pending the outcome of the reparations parley. The recent rise in the New York Federal Reserve rediscount rate has aroused a great deal of alarm among dealers as well as consumers, both here and in England. In spite of these developments, the German economic system appears once more to have turned the corner after a rather protracted depression.

Measured by importations of non-ferrous metals, the first half of the year has apparently witnessed some contraction in business. German importations of metals in the January-June period, in metric tons, showed the following totals:

	1929	1928
Copper	147,235	165,719
Lead	76,260	66,226
Zinc	75,364	75,895
Tin	7,894	7,418
Aluminum	6,643	7,937

Because of the high prices now obtaining for copper, smelters and refiners are being encouraged to import foreign copper ores and to work them up here. As a matter of fact, the importation of copper ores into Germany has been on the increase, as may be seen from the following semi-annual statistics:

	Metric Tons
1926—January-June	63,621
July-December	78,753
1927—January-June	108,627
July-December	150,266
1928—January-June	158,211
July-December	206,038
1929—January-June	257,010

Of course, Germany has still a long way to go in the matter of increasing copper-smelting operations, but surely the mounting ore imports may be regarded as a sign of the times.

An increase in copper imports from sources outside of the United States is to be recorded. American deliveries have shrunk, but shipments from the Congo and Canada have increased. The Congo shipped 13,792 tons of copper to Germany in the first half of the current year, against 4,622 tons in the same time last year. Canada has sent 4,550 tons, against 1,905 tons in the first half of 1928. The copper price situation still is the most discussed item in metal centers. Industrialists believe that a policy of cheapening prices would once more offer an extraordinary opportunity for expanding the market for the metal. Exertions are being made to market the increasing output of the African producers in Germany.

In the first six months of 1929 Germany, in spite of sharp competition, was able to export manufactured copper valued at 151.2 million marks, against 135.6 million marks in the second half of last year, and 124.3 million marks in the first half of 1928.

German zinc production in July was on the up grade, notwithstanding Brussels' restrictive measures. According to the Metallgesellschaft, the output totaled 9,092 tons, against 8,975 tons in June, though the difference of one day must be taken into account. Zinc stocks are increasing in Germany as well as in Polish Upper Silesia. The weakening quotations for G.B.O. in London are ascribed to the counter-crossing of Brussels' restrictions and the volume of new construction of some of the most prominent members of the Syndicate. Erection of additional electrolytic zinc plants may aggravate the situation.

German metal circles believe that the formation of the all-British Imperial Smelting Company, which, according to plans announced, will comprise Asiatic and Australian undertakings, may one day be extended to African and Canadian operations.

Expansion in the use of aluminum in connection with building construction is indicated by the fact that aluminum roofing has been applied in more than one instance in Berlin in place of galvanized sheets. I have examined a large block roof made of aluminum and found the outer appearance as to design very good.

The manganese market is attracting wide attention. According to Russian advices there exists a secret trade agreement between British and other producing interests. Russia intends to hold the upper hand in this field in world markets by forcing up production in the Tschiaturi district relinquished by Harriman. The recently reported offer by the United States Steel Corporation to buy 80,000 to 150,000 tons of Russian manganese yearly for a period of five years is cited as an example of Russian activity in this direction. According to the so-called five years' economic plan, the output is to be increased to 2,290,000 metric tons in 1933-34, against 1,230,000 tons last year. Russian calculations are to the effect that world steel production by 1933 will amount to not less than 140,000,000 tons. Indian manganese fields are believed in some quarters to be in a state of exhaustion.

Hecla Mining Shows Gain for Second Quarter

HECLA Mining Company reports for the quarter ended June 30, 1929, profit of $546,318 after ordinary taxes, depreciation and other charges, but before federal taxes, which compares with $493,037 in the preceding quarter and $348,638 in the second quarter of last year. Profit in first six months of the current year totaled $1,039,356 before federal taxes, against $713,173 in first half of 1928.

Income account for first and second quarters of 1929 follows:

	First Quarter, 1929	Second Quarter 1929
Gross income	$981,306	$1,016,651
Operating expenses	376,255	347,238
Taxes accrued	85,500	92,000
Depreciation	26,514	31,094
Total expenses	488,268	470,333
Net profit	493,037	546,318

The company produced 15,828,667 lb. of lead in the second quarter, against 15,068,653 lb. in the first quarter of 1929. Production of zinc in the second quarter amounted to 568,642 lb., against 162,476 lb. in the first three months of this year. Silver production for the second quarter totaled 454,791 oz., against 419,333 oz. in the first quarter.

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Chief Consolidated Mining Company, Utah, reports net profit for first half of 1929, after deducting loss sustained by a subsidiary company, of $165,410. Net profit on operations was $24,533. Profit derived from purchase and sale of miscellaneous investment items, including interest from investments, was $195,405. Net surplus on June 30, 1929, was $3,504,224.

Exports of Phosphate Rock from the United States during the first half of 1929 reached 542,700 tons, valued at $2,569,800. This commodity has been shipped to foreign countries for a great many years, and despite the competition from the African phosphates during the last ten years has been able for the most part to hold its own in foreign markets

London Financial News

By W. A. Doman
Special London Correspondent

London, Aug. 20, 1929. — Tin is not yet being boomed, but it is certainly receiving a greater amount of attention. A prominent person in the lead-zinc world says that he has no interest in tin winning, but he looks upon it favorably from the standpoint of investment in the shares of producing companies. As he is associated with others who are engaged in non-ferrous metal mining, his remarks are perhaps significant; but for producers of tin to talk of a coming famine in the metal, and at the same time to search around for increased industrial applications of tin, seems rather contradictory. One aim of tin research, however, is to investigate the properties of the metal, and a new line appears to be open in the prevention of corrosion. By mixing a small amount of tin with lead, and adding a smaller quantity of another non-ferrous metal, experiment has demonstrated that the strength of the lead was increased enormously, as was its resistance to corrosion and cracking. This new alloy may save many hundreds of thousands of pounds a year to the electrical industry and the building trades.

The price of tin is now £209 8s. 6d. per ton. At this level the Malayan companies can earn handsome profits, though there are others that have no margin whatever. They make proposals to the directors of successful undertakings for stabilization, restriction of output, and "rationalization," which proposals are not altogether accepted, because, as one prominent engineer remarked to me, "They knew nothing of tin mining when they made a bid for success, and if they cannot pay dividends on the high figure at which they acquired their shares, their misfortune is the price they have to pay for entering what is to them a new and an untried market."

Ropp Tin (Nigeria) has passed resolutions for amalgamation with the London Tin Syndicate, the latter paying 140,000 £1 fully paid shares, and at the same time increasing its capital from £600,000 to £1,000,000. Ropp was the pioneer of bucket dredging in Nigeria and among the earliest of the British Empire's tin-dredging enterprises.

The Eagle Lead Company (Derbyshire) has proved a disappointment hitherto. The plant "was of American origin and was of a very difficult and technical character." Colonel Rowland Feilding, managing director, says that in his view the metallurgical difficulties have been overcome, though the directors now doubt the former estimates of ore reserves.

A rumor has just reached me that a technical report on the Kansanshi mine of the Rhodesia Katanga Company has been made by a first-class authority, and will be published soon.

I learn that the British Swiss International Corporation has paid £302,000 to the government of the Union of South Africa, the sum being the estimated cost of the railway now being constructed between Koopmansfontein and Postmasburg (Cape Province). In the same connection, the Manganese Corporation (1929) has deposited with the Union government securities of the Union totaling £100,000. The working capital of the Manganese Corporation, amounting to £400,000, has been privately subscribed.

Second Quarter Earnings of Nevada Consolidated Off

Nevada Consolidated Copper Company reports net profit for second quarter of 1929 of $3,786,253, against a total of $6,724,519 in the first quarter of the current year. Results of the second quarter's operations, compared with those of the preceding quarter, follow:

	Second Quarter	First Quarter
Operating profit from copper production.	$3,289,052.66	$6,361,659.36
Value of precious metals	381,453.25	431,643.17
Miscellaneous revenues	549,312.84	364,782.10
Total operating income	$4,219,818.75	$7,158,084.63
Depreciation	433,565.25	433,565.25
Net income	$3,786,253.50	$6,724,519.38

Copper produced in the second quarter totaled 72,616,900 lb., against 78,381,399 lb. in the first quarter.

Utah Copper Company Reports Large Earnings

The operating statement of the Utah Copper Company for the second quarter of 1929 reports net income of $8,163,967, against $10,862,404 in the first quarter. The results of the company's operations for the three months ended June 30, 1929, compared with the previous quarter, are:

	Second Quarter, 1929	First Quarter, 1929
Net profit from copper production	$5,719,638.87	$8,472,200.72
Miscellaneous income, inc. gold and silver	1,125,270.58	1,057,214.72
Income from investments	1,640,262.75	1,640,262.75
Total income	$8,485,172.20	$11,169,678.19
Depreciation	321,204.76	307,274.09
To surplus	$8,163,967.44	$10,862,404.10

The average cost per pound of net copper produced in the April-June period was 6.4c., which compares with 6.3c. for the first quarter of the year.

Total Value of California Mine production of gold, silver, copper and lead in 1928, according to final figures compiled by the U. S. Bureau of Mines, was $15,381,783, a decrease of 9 per cent as compared with 1927. Production of gold declined 8 per cent. The output of silver was 9 per cent less in quantity and 6 per cent less in value than in 1927. Production of copper decreased 8 per cent in quantity, but the value increased 2 per cent. The output of lead decreased 30 per cent in quantity and 36 per cent in value. No zinc was reported produced in the state in 1928.

Burma Corporation during the month of July mined 39,573 tons, including 3,550 tons of high-grade ore. A total of 30,000 tons of ore was milled in the treatment plant, producing 9,620 tons of lead concentrate, and 11,778 tons of lead-bearing material, including 2,998 tons of high-grade ore, was smelted in the blast furnaces, producing 6,325 tons of hard lead for treatment in the refinery. Refinery products were 6,500 tons of refined lead and 580,923 oz. of refined silver. Of silver production 15,334 oz. was recovered from the treatment of copper matte. The zinc plant produced 5,000 tons of zinc concentrates, assaying 7.98 oz. silver, 4.06 per cent of lead, and 52.39 per cent of zinc.

In addition, about 830 tons of copper matte was produced from the treatment of accumulated smelter byproducts and 4,423 tons copper ore. A total of 100 tons of refined antimonial lead was also produced. Included in the tonnage of refined lead is 84 tons recovered from the smelting of copper ore.

Vanadium Corporation of America reports for six months ended June 30, 1929, net income of $1,177,688 after depreciation, depletion, federal taxes, and other charges, equivalent to $3.12 a share earned on 376,637 shares of no-par stock. This compares with $969,492 or $2.57 a share in first half of 1928.

Chilean Nitrate Production for the first half of 1929 amounted to 16,186,115 metric quintals. Shipments to foreign countries for the same period reached a total of 15,028,039 metric quintals. The number of oficinas working at the close of the half year was reported as 67.

American Manganese Fertilizer Corporation, of Alexandria, Va., has been granted a charter with a maximum capital of $550,000, to explore, develop, and operate mines and manufacture fertilizers. Albert S. Dulin, of Washington, D. C., is president.

Production of Potash in France during May, 1929, amounted to 37,242 metric tons, against 38,990 tons in April, 1929, and 32,043 tons in May, 1928.

Production of Metallic Cadmium in the United States in 1928 amounted to 1,875,896 lb., according to the U. S. Bureau of Mines. This is an increase of 75 per cent in quantity over the production in 1927. A total of 233,101 lb. of cadmium was imported into the United States last year, against 22,400 lb. in 1927.

Directors of Arcadian Consolidated recently called an assessment of 50c. a share, payable Sept. 5, to enable the company to continue development work. The books closed Sept. 4.

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London Spot		Sterling Exchange	
	1928	1929	1928	1929	1928	1929
January	57.135	57.019	26.313	26.257	487.098	484.577
February	57.016	56.210	26.205	25.904	487.008	484.787
March	57.245	56.346	26.329	26.000	487.558	484.776
April	57.395	55.668	26.409	25.738	487.785	484.808
May	60.298	54.125	27.654	25.084	487.685	484.599
June	60.019	52.415	27.459	24.258	487.565	484.330
July	59.215	52.510	27.262	24.289	485.923	484.560
August	58.880	52.579	27.096	24.288	484.979	484.368
September	57.536	.....	26.440	.....	484.654	.....
October	58.087	.....	26.727	.....	484.584	.....
November	57.953	.....	26.704	.....	484.492	.....
December	57.335	.....	26.349	.....	484.698	.....
Year	58.176	.....	26.746	.....	486.169	.....

New York quotations, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York		London Spot			
	Electrolytic		Standard		Electrolytic	
	1928	1929	1928	1929	1928	1929
January	13.854	16.603	61.912	75.551	66.575	78.602
February	13.823	17.727	61.670	78.228	66.381	83.538
March	13.845	21.257	61.148	89.153	66.443	98.356
April	13.986	19.500	61.678	81.036	66.500	89.405
May	14.203	17.775	62.554	75.026	67.216	83.727
June	14.527	17.775	63.664	74.338	68.738	84.013
July	14.527	17.775	62.881	72.152	68.670	84.043
August	14.526	17.775	62.472	73.783	68.750	84.250
September	14.724	.....	63.522	.....	69.800	.....
October	15.202	.....	65.524	.....	71.935	.....
November	15.778	.....	68.080	.....	74.750	.....
December	15.844	.....	69.336	.....	75.000	.....
Year	14.570	.....	63.703	.....	69.230	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London			
	1928	1929	1928	1929	1928 Spot	1928 3 Mos.	1929 Spot	1929 3 Mos.
January	6.500	6.650	6.280	6.498	21.773	22.213	22.111	22.344
February	6.325	6.853	6.069	6.739	20.283	20.747	23.128	23.156
March	6.000	7.450	5.805	7.348	19.938	20.352	25.409	25.591
April	6.100	7.187	5.991	7.025	20.306	20.563	24.783	24.408
May	6.123	7.000	6.012	6.761	20.483	20.813	23.949	23.750
June	6.300	7.000	6.152	6.790	20.985	21.211	23.694	23.603
July	6.220	6.804	6.038	6.607	20.602	20.957	22.810	22.880
August	6.248	6.750	6.056	6.553	21.634	21.628	23.185	23.259
September	6.450	.....	6.286	.....	22.050	21.769	.....	.....
October	6.500	.....	6.318	.....	22.082	21.796	.....	.....
November	6.389	.....	6.222	.....	21.239	21.469	.....	.....
December	6.495	.....	6.343	.....	21.342	21.730	.....	.....
Year	6.305	.....	6.131	.....	21.060	21.271	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York		London	
	1928	1929	1928	1929
	Straits		Spot	
January	55.650	49.139	253.222	222.727
February	52.440	49.347	233.833	223.138
March	52.220	48.870	232.722	220.781
April	52.270	45.858	234.204	206.887
May	51.582	43.904	230.886	197.545
June	47.938	44.240	217.280	200.206
July	47.040	46.281	212.449	209.473
August	48.012	46.619	212.847	209.815
September	48.073	.....	215.663	.....
October	48.966	.....	222.005	.....
November	50.750	.....	232.875	.....
December	50.185	.....	227.586	.....
Year	50.427	.....	227.131	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1928	1929	1928 Spot	1928 3 Mos.	1929 Spot	1929 3 Mos.
January	5.643	6.350	26.125	26.051	26.196	26.233
February	5.551	6.350	25.518	25.506	26.247	26.347
March	5.624	6.463	25.082	24.960	27.050	27.294
April	5.759	6.658	25.493	25.316	26.759	26.613
May	6.026	6.618	26.102	25.756	26.727	26.619
June	6.158	6.686	25.664	25.429	26.216	25.984
July	6.201	6.766	24.946	24.972	25.332	25.418
August	6.249	6.800	24.540	24.713	24.896	25.164
September	6.250	.....	24.497	24.625	.....	.....
October	6.250	.....	24.030	24.296	.....	.....
November	6.263	.....	24.801	24.827	.....	.....
December	6.349	.....	26.609	26.615	.....	.....
Year	6.027	.....	25.284	25.256	.....	.....

St. Louis quotations, cents per pound. London pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a)		Quicksilver (b)		Platinum (c)			
					Refined		Crude	
	New York		New York		New York			
	1928	1929	1928	1929	1928	1929	1928	1929
Jan.	10.863	9.558	123.620	119.481	79.280	70.000	69.280	60.000
Feb.	10.842	9.548	121.370	119.818	84.783	70.000	74.783	60.000
March	10.083	9.531	122.557	121.904	80.000	70.000	70.000	60.000
April	9.865	9.462	123.740	122.000	80.000	70.000	70.000	60.000
May	11.019	8.957	123.173	121.154	78.000	68.615	68.000	58.615
June	9.750	8.845	122.423	120.500	78.000	68.000	68.000	58.000
July	9.540	8.543	121.260	121.654	78.000	68.000	68.000	58.000
Aug.	10.181	8.778	124.500	125.111	78.000	68.000	68.000	58.000
Sept.	10.813	.....	128.000	.....	78.000	.....	68.000	.....
Oct.	10.841	.....	125.923	.....	78.000	.....	68.000	.....
Nov.	10.109	.....	123.000	.....	76.417	.....	66.418	.....
Dec.	9.748	.....	122.500	.....	74.480	.....	64.480	.....
Year	10.305	.....	123.506	.....	78.580	.....	68.580	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce.

Pig Iron[1] and Aluminum

	Bessemer		Basic		No. 2 Foundry		Aluminum	
	1928	1929	1928	1929	1928	1929	1928	1929
Jan.	17.50	18.00	17.00	17.50	17.25	17.50	24.300	24.300
Feb.	17.50	18.00	17.00	17.50	17.25	17.50	24.300	24.300
March	17.50	18.19	17.00	17.62	17.25	17.69	24.300	24.300
April	17.50	18.50	17.00	18.00	17.25	18.00	24.300	24.300
May	17.37	18.81	16.38	18.31	17.24	18.31	24.300	24.300
June	17.00	19.00	15.56	18.50	16.79	18.50	24.300	24.300
July	17.00	19.00	15.75	18.50	16.69	18.50	24.300	24.300
Aug.	17.00	19.00	15.75	18.50	16.50	18.50	24.300	24.300
Sept.	17.00	.....	15.75	.....	16.50	.....	24.300	.....
Oct.	17.24	.....	16.66	.....	16.74	.....	24.300	.....
Nov.	17.82	.....	17.32	.....	17.32	.....	24.300	.....
Dec.	18.00	.....	17.50	.....	17.50	.....	24.300	.....
Year	17.37	.....	16.56	.....	17.02	.....	24.300	.....

Iron in dollars per long ton. Aluminum in cents per pound, 99 per cent grade.

[1]F.o.b. Mahoning and Shenango valley furnaces; freight to Pittsburgh, $1.76.

Monthly Crude Copper Output in Short Tons

	Domestic						
	1928	1929					
	Total	Feb.	Mar.	April	May	June	July
Alaska shipments	22,724	913	1,974	2,075	1,801	1,793	1,514
Calumet & Arizona	65,182	5,553	5,888	6,041	6,731	5,286	4,986
Magma	18,251	1,450	1,680	1,780	2,022	1,664	1,616
Miami	24,129	2,157	2,620	2,591	2,416	2,416	1,763
Nevada Con.	134,231	.....	†39,191	.....	.....	†36,309	.....
Old Dominion*	11,069	734	1,015	1,040	1,022	782	898
Phelps Dodge††	102,137	9,537	10,524	10,230	9,857	8,901	9,274
United Verde Extens.	22,073	2,024	2,504	2,682	2,732	2,510	2,235
Utah Copper	136,920	.....	†40,500	.....	.....	†42,310	.....
Tennessee Copper	6,792	616	635	619	676	638	677
Foreign							
Andes Copper	52,029	7,000	8,300	8,263	7,393	6,871	.....
Braden	109,137	4,830	9,375	9,265	7,630	7,630	.....
Boleo, Mexico	12,782	.....	†2,910	.....	.....	3,637	.....
Bwana M'Kubwa	6,696	605	686	615	317	536	701
Chile	132,932	15,085	16,720	16,373	14,852	12,060	.....
Furukawa, Japan	17,865	1,473	1,751	1,350	1,600	1,506	.....
Granby Cons., Canada	28,767	2,324	2,452	2,631	2,591	2,518	2,467
Howe Sound	21,099	.....	†5,157	.....	.....	.....	.....
Mt. Lyell	6,582	.....	1,707	.....	.....	.....	.....
Sumitomo, Japan	17,898	1,335	1,680	1,657	1,718	.....	.....
Union Miniere, Africa	123,880	9,477	11,820	12,810	13,224	12,673	13,216

†Three months. *Includes Arizona Commercial.
††Moctezuma is included.

Monthly Production of Primary Copper from U. S. Mines and Daily Rate (Short Tons)

	1927		1928		1929	
	Monthly Production	Daily Rate	Monthly Production	Daily Rate	Monthly Production	Daily Rate
January	76,198	2,458	68,469	2,209	86,325	2,785
February	69,202	2,472	67,423	2,352	84,735	3,026
March	69,314	2,236	70,327	2,269	93,698	3,023
April	71,122	2,371	69,721	2,324	94,902	3,163
May	71,613	2,310	73,729	2,378	93,392	3,013
June	69,539	2,318	73,224	2,441	82,354	2,745
July	65,545	2,114	73,426	2,369	79,329	2,559
August	67,248	2,169	76,952	2,482	.....	.....
September	65,936	2,198	78,341	2,611	.....	.....
October	68,545	2,225	86,480	2,790	.....	.....
November	68,080	2,269	85,382	2,846	.....	.....
December	67,377	2,173	85,677	2,764	.....	.....
Total	829,978	.....	909,051	.....	614,735	.....
Monthly average	69,165	.....	75,754	.....	87,819	.....
Average of daily rate	.....	2,274	.....	2,484	.....	2,904

The Market Report

Copper Buyers Stampede for Record Tonnage

New York, Sept. 4, 1929—All records were broken for copper buying this week, when domestic buyers entered the market for a total of 102,000 tons, which far surpasses the previous record of about 56,000 tons sold in the week ending Dec. 26, 1928, which, curiously enough, was also a holiday week. About 35,000 tons of this was sold in one day, yesterday, since when inquiry has tempered slightly, and some sellers have withdrawn from the market.

Foreign business has also been active, about 18,000 long tons having been booked at the Copper Exporters price of 18.30c. so far this month, up to noon today.

One leading seller, in view of the heavy tonnage sold, withdrew from the market on Friday afternoon, and since then has established his quotation at 18¼c., Connecticut basis, but business at that level has been small. Other sellers, swamped with orders, have gradually withdrawn also, though without marking up their price. Today, two large sellers continued to quote 18c., large orders being booked at that level; they do not favor an increase. In fact, most sellers would rather see 18c. maintained than to have the conditions of last spring duplicated. They admit, however, that continued active buying is likely to force up prices.

Though most of the buying has been for September-October, a substantial business has been done for the last two months of the year as well.

Lead has been less active than last week, though a heavy tonnage has been sold for all that, with all classes of buyers represented, largely for September or October shipment. The price trend is upward, with the leading mid-Western producer at 6.60c., St. Louis, today, and some lead having been sold in the East at the equivalent of 6.80c., New York, though the A. S. & R. contract price remains at 6.75c.

Zinc and tin have been dull. The price of the former continues firm at 6.80c. for all positions, but tin drooped a little when the increase of 2,600 long tons in visible supplies at the end of August became known.

Closing cable quotations on the principal European exchanges on Tuesday, Sept. 3, were: Francs, 3.91½c.; lire, 5.22½c.; and marks, 23.79⅜c. Canadian dollars, ⅜ per cent discount.

The silver market was quiet and dull during the week, and prices eased off slightly as a result of weakness in China exchanges. India has shown very little interest, and the tendency is uncertain.

Mexican Dollars (old Mexican pesos): Aug. 29th and 30th, 39⅞c.; 31st, 39⅝c.; Sept. 2d, holiday; 3d, 39½c.; 4th, 39⅝c.

Daily Prices of Metals

Aug. Sept.	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
29	17.775	46.125	6.75	6.55	6.80
30	17.775	46.25	6.75	6.55	6.80
31	17.775	No Market	6.75	6.55	6.80
2	Holiday	.....	....	....	....
3	17.775	45.50	6.75@6.80	6.55	6.80
4	17.775	45.875	6.75@6.80	6.575@6.60	6.80
	17.775	45.938	6.760	6.558	6.800

Average prices for calendar week ending Aug. 31, 1929, are: Copper, 17.775; Straits tin, 46.175; New York lead, 6.750; St. Louis lead, 6.550; zinc, 6.800; and silver, 52.583.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Aug. Sept.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic bid						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
29	73 7/8	74 3/4	84 1/4	207 7/8	212	23 7/16	23 9/16	24 13/16	25 1/8
30	74 1/2	75 1/4	84 1/4	208 3/4	212 1/2	23 7/16	23 9/16	24 13/16	25 1/16
2	75 1/8	75 13/16	84 1/4	206 1/4	210 1/4	23 9/16	23 5/8	24 1/16	24 3/4
3	75 9/16	76 1/2	84 1/4	204 1/2	208 1/2	23 9/16	23 5/8	24 1/4	24 7/8
4	78 7/8	79 13/16	84 5/8	206	210	23 5/8	23 5/8	24 7/16	25 1/8

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Aug.	Sterling Exchange "Checks"	Silver		Gold London	Sept.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
29	4.84 1/4	52 5/8	24 5/16	84s11½d	2	Holiday	....	24 5/16	84s11½d
30	4.84 1/4	52 5/8	24 1/4	84s11½d	3	4.84 1/4	52 1/8	24 1/16	84s11½d
31	4.84 3/16	52 1/4	24 3/16		4	4.84 1/4	52 1/4	24 3/16	84s11½d

Average: Silver, 52.375c.; Sterling Exchange, 484.238c.

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Average Metal Prices for August, 1929

COPPER:	
New York Electrolytic	17.775
London Standard Spot	73.783
London Electrolytic Spot	84.250
LEAD:	
New York	6.750
St. Louis	6.553
London Spot	23.185
London Forward	23.259
SILVER:	
New York	52.579
London	24.288
Sterling Exchange	484.368
ZINC:	
St. Louis	6.800
London Spot	24.896
London Forward	25.164
TIN:	
Straits	46.619
London	209.815
QUICKSILVER	125.111
ANTIMONY	8.778
PLATINUM:	
Refined	68.000
Crude	58.000
ALUMINUM 99 Per Cent Plus	24.300

Tri-State Mines Will Close One Week

Joplin, Mo., Aug. 31, 1929

Blende		Per Ton
High		$46.60
Premium blende, basis 60%		44.00
Prime Western, basis 60%	$43.00@	44.00
Table concentrates, 60%	41.00@	43.00
Flotation concentrates, 60%	39.00@	41.00
Average settling price, all zinc ore		43.99
Galena		
High		$87.90
Basis 80 per cent lead		85.00
Average settling price, all lead ore		86.52

Shipments for the week: Blende, 12,864 tons; lead, 1,576 tons. Value all ore the week, $702,220.

Shipments for the year to date: Blende, 436,346; lead, 69,374 tons. Value all ore the year to date, $24,995,520.

Price offerings for zinc and lead concentrates continue unchanged, with the demand firm. Production again declined this week and the shutdown next week will lower the output around 9,000 tons.

Summarizing June concentrate production, and drawing a comparison of costs and percentage recovery, the following conclusion has been deduced: The average cost of producing a ton of concentrate was slightly higher than in May and was the highest since last September. Percentage recovery for June was the lowest since January, evidencing a steady advance in production costs. The recovery is also lower than the average for several years, and this suggests that some of the mines may have been depleted of the richer ore reserves.

Platteville, Wis., Aug. 31, 1929

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$46.75
Lead Ore	
Lead, basis 80 per cent	$85.00

Shipments for the week: Blende, 669 tons; lead, none. Shipments for the year: Blende, 23,160; lead, 1,300 tons. Shipments for the week to separating plants, 1,683 tons blende.

Business in Steel Is Seasonally Light

Pittsburgh, Sept. 3, 1929

Steel buying in August, in new orders and in specifications or shipping orders against contract, was rather light, being well under the shipments, but this did not presage much decrease in shipments, for the double reason that, with the scarcity of steel ended, consumers were reverting to a hand-to-mouth buying policy and that during the vacation season buying can be allowed to slip somewhat, in anticipation of heavier commitments in September.

The peak rate of steel production was reached in May, there being a little decrease month by month since then, but the rate at the close of August was probably not more than 10 per cent under May rate. Small further decreases are expected to the end of the year. Steel-ingot production in the first half of the year was 29,000,000 long tons and the second half may total about 26,000,000 tons, making 55,000,000 tons for the year, 10 per cent over the record for 1928; and 1928 was 7 per cent over 1926, production having been slightly off in 1927.

Decreases in steel requirements are chiefly of seasonal character. The automobile industry absorbed about 23 per cent of the steel made in the first half of the year, from July to October inclusive it may be engaging about 18 per cent of the steel capacity, and November and December are usually light months. Annual rail orders are practically completed and rail production is materially reduced, two months later than usual. Freight-car shops are nearing the end of their orders and in a few weeks will be taking little steel. The agricultural-implement industry is running somewhat under its high rate of the first half of the year. Structural fabricating shops have a large order book. In each of the six months, February to July inclusive, they booked more than they shipped.

Finished-steel prices are steady, following recent declines in black and galvanized sheets, plain wire, and wire nails.

Pig Iron.—The markets were all dull in August, but more buying is expected, seasonally, this month. The Valley market has been firm at $19 for Bessemer and $18.50 for basic and foundry, f.o.b. furnaces. Alabama furnaces maintain $14.50, furnace, for local delivery, but have offered iron in the North on a basis of $13.50 and less.

Connellsville Coke.—The market has been dull. Spot furnace coke eased off slightly in August, being now $2.75 flat, spot foundry remaining at $4@$4.25 for regular standard grade.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c. London, 98 per cent, quoted at £95 per long ton, less 2 per cent for domestic consumption.

ANTIMONY—Per lb., duty paid: Chinese brands, for all positions, 8¼c. Cookson's "C" grade, spot, 14c. Chinese needle, lump, 8c. Standard powdered needle, 200 mesh, 10c.

BISMUTH—Per lb., in ton lots, $1.70. Smaller lots $1.85 and up. London 7s. 6d.

CADMIUM—Per lb., 80@90c. London, 3s.11d.@4s. for prompt.

CHROMIUM — Per lb., 97 per cent grade, $1.50.

COBALT — Per lb., f.o.b. Canadian works: Shot or rondelles, 97@98 per cent, $2.50. Contract sales booked at discounts, depending on quantity. Black oxide, 70 per cent, $2.10. London, nominal, 10s. for metal in small lots, 8s. for black oxide; 8s. 10d. for gray.

[1]GERMANIUM OXIDE—Per gram in 300- to 500-gram lots, $3.50.

IRIDIUM—Per oz., $230@$240 for 98 @99 per cent sponge and powder. London, £48@£50.

[1]LITHIUM—Per oz., 98@99 per cem grade in 1- to 5-lb. lots, $5.

MAGNESIUM—Per lb., single orders for spot metal: 8-lb. ingots (3x3x15 or 16 in.), 95c.@$1.05, depending on quantity; 2½- or 3-lb. sticks (1⅛ in.) 90c.@$1.10, depending on quantity; 10-oz. sticks (1x12 in.), 80@90c. Discounts up to 20 per cent on larger orders or contracts. London 3s. 3d.@ 3s. 6d. for 99 per cent ingots or sticks.

[1]MOLYBDENUM—Per lb. in 1- to 3-lb. lots, 99 per cent, $18. (Usually sold as calcium molybdate or ferromolybdenum, which see).

NICKEL—Per lb., ingot 35c.; shot 36c.; electrolytic, 35c. (99.90 per cent), for single lots of spot metal. London, per long ton, £175. Business brisk and prices firm, according to *The Metal Bulletin*, London.

OSMIUM—Per oz., $58@$65; London, £12@£13 10s.

PALLADIUM — Per oz., $38@$40. London, £6 17s. 6d.@£7.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $68. Transactions between dealers and refiners in the outside market are commonly reported at several dollars less. London, per oz., £13 10s.@£13 15s. for refined; crude and scrap, nominal at £11 10s.@£12.

QUICKSILVER—Per 76-lb. flask, $125. Market strong on small offerings from Europe. San Francisco wires $128. London steady, with offers of spot at £22 5s.@£22 10s.

RADIUM — Per mg. radium content, $70.

RHODIUM—Per oz., $45@$55. Nominal. London, £11@£13.

RUTHENIUM — Per oz., $42@$50., Nominal. London £9@£10 10s.

[1]SELENIUM — Per lb. in ton lots: Black, powdered, amorphous, 99.5 per cent pure, $2.25. London, 7s. 8d.@ 7s. 9d.

TANTALUM — Per gram: Bar and heavy sheet, chemically pure, 16c.; tantalum powder, 11c. Increasing demand from radio tube makers.

TELLURIUM—Per oz., 15@18c.

THALLIUM METAL—$12.50@$15 per pound.

TITANIUM—Per lb., 80@90 per cent grade, $5.

TUNGSTEN POWDER—Containing 97 to 98 per cent tungsten, per lb., $1.35@ $1.50, depending on quantity. Nominal.

VANADIUM—Per gram, 92@95 per cent grade, $1.25.

[1]ZIRCONIUM METAL—Per oz., 98 per cent grade, $1.56 in 5- to 10-lb. lots.

[1]Price furnished by Foote Mineral Company, Philadelphia.

KAOLIN—See China Clay.

[1]LEPIDOLITE—Per ton: $20@$30 for ordinary grades. Nominal.

LIMESTONE—Per ton: f.o.b. shipping points, depending on location, either lump or crushed, 25c.@$3.

Agricultural, 75c. up to $5 for crushed or pulverized. Prices depend upon source, purity, and fineness.

MAGNESITE — Per short ton, f.o.b. *California* mines: Grade "A" calcined, 80 per cent through 200 mesh, $43; Grade B, $40; dead burned, $29; crude, $11. *Washington:* Dead-burned magnesite, $22@$24 per net ton, Chewelah, Wash.

MICA—Per ton, f.o.b. plant:

New Hampshire: Mine run sheet and punch, $320@$340; clean shop scrap, $25; roofing, $30@$35. White dry ground, 20 mesh, $28; 40 mesh, $40; 60 mesh, white, $60; off-color, $34; 100 mesh, $65; 200 mesh, $80. Granite mica facings for cement block and stucco use, $8@$12, depending on size between ¼ in. and 60 mesh. Disks, 1¼ in. No. 1, $1.25; 2½x2 in. square cuts, $3.25.

North Carolina: White, ground, 20 mesh, $35; 70 mesh, $100.

Madagascar, amber, per lb., f.o.b. *New York*, duty paid: No. A1, $2.50; No. 1, $2; No. 2, $1.65; No. 3, $1.15; No. 4, 60c.; No. 5, 45c.

[1]MONAZITE—Per ton: (Minimum 6 per cent ThO_2), $80.

OCHER — F.o.b. *Georgia* mines, per ton: $19@$20 in sacks; $21@$22 in barrels; washed and water floated, $18; second grade, 99 per cent through 225 mesh, $18. Market fair.

PHOSPHATE—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7.15; 75 per cent, $6.40; 74@75 per cent, $6.15; 70 per cent, $4.65; 68 per cent, $4.10. Prices firm.

Florida, pebble, domestic: 76@77 per cent, $6.50; 74@75 per cent, $5.50; 72 per cent, $4.50; 70 per cent, $4. Dull.

Tennessee, ground, 80 per cent through 300 mesh, 33 per cent P_2O_5, $11.80 per short ton. Brown lump for acid manufacture, per gross ton, $6 on 75 per cent basis; $5.25 on 72 per cent basis. Non-acidulated, fine ground, 65 per cent, $8 (per short ton).

POTASH—The ruling contract prices (short tons) are as follows:

	Bags	Bulk
Muriate of potash, 80@85 per cent, basis 80 per cent..	$36.75	$35.15
Sulphate of potash, 90@95 per cent, basis 90 per cent	47.75	46.15
Sulphate of potash-magnesia, 48@53 per cent, basis 48 per cent	27.50	25.90
Manure salt, 30 per cent...	21.95	18.95
Manure salt, 20 per cent...	15.50	12.50
Kainit, 14@16 per cent ...	12.60	9.60
Kainit, 12.4 per cent.....	12.10	9.10

PUMICE STONE—Per lb.: In barrels, powdered, 2½@4c.; selected lump, 5@7c.

PYRITES—Per long ton unit of sulphur: C.i.f. United States ports; guaranteed 48 per cent sulphur: Spanish, 13c.; Tharsis, furnace size, 2½ in. diameter, 14c. Cinder from ore to remain property of buyers.

[1]QUARTZ ROCK CRYSTALS—Per lb. in ton lots: Colorless, clear but flawed, pieces ¼ to ½ lb. in weight, 20c. For optical purposes, four times above price; larger crystals still higher.

SILICA—Per ton: Water ground and floated, in bags, f.o.b. Illinois: 325 mesh, $16@$31 for 90 to 99½ per cent grades. Market fair. Glass sand, f.o.b. producing plant, 75c.@$5 per ton; molding sand, 65c.@$3.50; blast sand, $1.35@$3.50.

[1]SPODUMENE — Per ton: $20@$30, depending upon lithium content.

SULPHUR—Per long ton for domestic market, $18 f.o.b. Texas mines; $22 for export, Atlantic ports.

TALC—Per ton, carload lots, f.o.b. works, containers included:

Vermont: 99 per cent through 200 mesh, extra white, $9@$9.50; 97½ to 98½ per cent through 200 mesh, medium white, $8.50@$9; packed in 50-lb. paper bags; prices $1 per ton less in burlap sacks plus 15c. net for bags packed 12 to the ton.

New York: Double air-floated, short fiber, 200 mesh, $13.75; 325 mesh, $14.75.

Georgia: Powdered, gray, $7.50@$10; yellow, $9@$12; red, $11@$13; roofing, $7.50@$9.

New Jersey: Soapstone, ground, $10@$12.

TRIPOLI—Per short ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri:* Once ground through 40 mesh, rose and cream colored, $16. Double ground through 110 mesh, rose and cream, $18. Air-floated through 200 mesh, rose and cream, $27.50; mill run, $16. Demand improving.

Metallic Compounds

ANTIMONY OXIDE—White, Chinese, 99 per cent Sb_2O_3, 10½@11c. per lb. Nominal.

ARSENIOUS OXIDE (White arsenic)—Per lb., 4c.; delivered all positions. Market firm. London, per long ton, £16@£16¼ quoted for Cornish white.

CALCIUM MOLYBDATE OR MOLYTE — Per lb. of contained Mo, 95c.@$1.

COPPER SULPHATE (Blue Vitriol)—Per lb. in car lots, 6c., for either large or small crystals.

SODIUM NITRATE—Per 100 lb.; crude natural, in bags ex vessel, Atlantic ports, $2.08 for September deliveries.

SODIUM SULPHATE (Salt Cake)—Per ton, bags, f.o.b. works, $16@$18; in barrels, $20.

ZINC OXIDE—Per lb. in bags, in car lots: Lead-free, 6½c.; 10, 20 or 35 per cent leaded grades, 6⅝c.; French red seal, in bags, 9¼c.

[1]Price furnished by Foote Mineral Company, Philadelphia.

Alloys

[1]FERROCERIUM—Per lb., $8 in 15- to 75-lb. lots.

FERROCHROME—Per lb. of contained chromium, 60@70 per cent chromium, 4 to 6 per cent carbon, 11c. on requirement contracts; spot shipments about 11½c. Freight allowed on carload lots east of Mississippi River and north of Baltimore. Active trade.

FERROMANGANESE — Per gross ton furnace: Domestic and foreign, 78@82 per cent, $105. Spiegeleisen, 19@21 per cent, $34 on carload business, f.o.b. furnace.

FERROMOLYBDENUM—Per lb. of Mo, f.o.b. shipping point, 50@60 per cent Mo, $1.25.

FERROPHOSPHORUS—Per ton, 18 per cent P, $91; electrolytic, 24 per cent, $122.50; f.o.b. *Alabama* and *Tennessee*.

FERROSILICON—Per gross ton, f.o.b. works, freight allowed on carload lots east of Mississippi River and north of Baltimore: 50 per cent, $83.50; 75 per cent, $130; 15@17 per cent, $45, f.o.b. Suspension Bridge, N. Y. Quotations for spot shipments $5@$10 per ton higher on 50 and 75 per cent grades.

FERROCARBONTITANIUM — Per ton: $160, f.o.b. producer's plant.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.45@$1.50, f.o.b. works.

FERROVANADIUM—Per lb. of V contained, f.o.b. works, freight allowed, $3.15@$3.50, depending on grade and quantity.

NICKEL SILVER—Per lb. for 18 per cent nickel Grade A sheets, 34¼c.

YELLOW (MUNTZ) METAL—Dimension sheets, per lb., 25c.; rods per lb., 22¼c.

Rolled Metals

COPPER—Sheets, hot-rolled, per lb., 27¼c.; wire, per lb., f.o.b. mill, 19⅞c.

LEAD SHEETS—Full rolled, 11c. per lb.; clipped, 11¼c.

MONEL METAL—Per lb., sheets, full finished, 42c.; rods, hot-rolled, 35c.

NICKEL—Per lb., sheets, full finished, 52c.; rods, hot-rolled, 45c.

ZINC SHEETS—Per lb., 10¼c., f.o.b. works.

Refractories

CHROME BRICK—Per net ton, f.o.b. shipping point, $45.

FIRECLAY BRICK — Per M.: First quality, $43@$46, *Ohio, Kentucky, Central Pennsylvania;* second quality, $35@$38.

MAGNESITE—Brick, per net ton, f.o.b. works: 9-in. straights, $65, f.o.b. plant. Cement, $40, seaboard.

SILICA BRICK—Per M., *Pennsylvania* and *Ohio*, $43; *Alabama*, $51; *Illinois*, $52.

ZIRKITE—Per lb.; Powdered, 65@70 per cent ZrO_2, 3½c. Brick, straights, 80c.@$1 each.

Metallic Ores

ANTIMONY ORE—Bolivian ore, 60 per cent metallic antimony, $1.35 per short ton unit, c.i.f. New York.

CHROME ORE—Per long ton, f.o.b. Eastern shipping points, Indian and Rhodesian ores, $21.50 for 46@47 per cent Cr_2O_3 ore to $23.50 for 50@51 per cent ore. New Caledonian ore, high-grade, $25.

IRON ORE—Per long ton, lower Lake ports. Lake Superior ores:

Mesabi, non-bessemer, 51½ per cent iron, $4.50. Old Range, non-bessemer, $4.65.

Mesabi, bessemer, 51½ per cent iron, $4.65. Old Range, bessemer, 51½ per cent, $4.80.

Eastern ores, cents per unit, delivered at furnaces: Foundry and basic, 56 to 63 per cent, 8c.

Foreign ores, f.o.b. cars Atlantic ports, cents per unit:

North African, low-phosphorus, 10@10½c.

Spanish and North African basic, 55@60 per cent, 10@10½c.

Swedish foundry or basic, 66@68 per cent, 9@10c.

Newfoundland foundry, 55 per cent, 8½@9c. Nominal.

MANGANESE ORE—Per long-ton unit of Mn, c.i.f. North Atlantic ports. Exclusive of duty. Brazilian and Indian ores, minimum 47 per cent Mn, 31@34c. Caucasian, 53@55 per cent, 36c. Cuban, minimum 47 per cent, 35c.

Per ton in carload lots:

[1]Chemical grades, powdered, coarse or fine, 82@87 per cent MnO_2. Brazilian and Cuban, $70@$80. Caucasian, minimum 85 per cent, $70. Montana, 70 to 75 per cent, $70@$80. Domestic, 70 to 72 per cent, $40@$50.

TANTALUM ORE—Per unit of Ta_2O_5, basis 60 per cent ore, $13.

TITANIUM ORE—Ilmenite, per gross ton, 50 per cent TiO_2, f.o.b. Atlantic seaboard, $9.50@$11, according to grade and impurities. Low-grade domestic, 32 to 35 per cent, about $7@$8 per gross ton. Rutile, per lb., guaranteed minimum 94 per cent concentrate, 10c. in carload lots.

TUNGSTEN ORE—Per short-ton unit of WO_3, N. Y.: Wolframite, $15.75@$16 for future delivery. Offerings have been somewhat larger, but prices holding firm. Bolivian scheelite is quoted at $16. Western scheelite, $16.50@$17 for October and November delivery.

VANADIUM ORE—Per lb. V_2O_5 contained, 28c.

ZIRCON ORE—Per net ton containing 55 per cent ZrO_2, f.o.b. Atlantic seaboard, $40@$45 in 30-ton lots.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.

[1]Price given by Foote Mineral Company, Philadelphia.

[1]AMBLYGONITE—Per ton, f.o.b. mines: 8@9 per cent lithium oxide, $50@$60.

ASBESTOS — Per ton: f.o.b. Quebec mines, tax and bags included, prices quoted by leading interest for delivery on 1929 contract:

Crude No. 1, $550@$750; crude No. 2, $450@$575; spinning fibers, $225@$275; magnesia and compressed sheet fibers, $175@$225; shingle stock, $55@$115, various grades; paper stock, $45@$50; cement stock, $25; short fibers, $10@$20; floats, $12@$15. Europe reports a general shortage of Canadian spinning fiber and No. 2 crude.

Per ton c.i.f. New York: Rhodesian crude No. 1, $450; No. 2, $350.

BARYTES—Per ton: f.o.b. mines, bags extra:

Georgia: Barytes ore, crude (per long ton), $7. Washed and water floated to 97 per cent through 325 mesh, $18. Demand fair.

Missouri: Water ground and floated, bleached, $23; $25 in less than car lots, f.o.b. works. Crude ore, 93 per cent $BaSO_4$, not to exceed 1 per cent iron, $7@$7.75. f.o.b. mines.

BAUXITE—Per long ton: Domestic ore, chemical, crushed and dried, 55 to 58 per cent Al_2O_3, 1.5 to 2.5 per cent Fe_2O_3, $7.50@$8.25 f.o.b. *Alabama* and *Arkansas* mines. Other grades, 56 to 59 per cent Al_2O_3, 5 to 8 per cent SiO_2, $6.75@$8.25 f.o.b. *Arkansas* mines. Pulverized and dried, $12@$14 f.o.b. *Arkansas* mines; calcined, 78 to 84 per cent Al_2O_3, $18@$20 f.o.b. *Arkansas* mines.

Per metric ton, foreign, c.i.f. Atlantic port: Dalmatian, 50 to 55 per cent Al_2O_3, 1 to 3 per cent SiO_2, $4.50@$6.50; Istrian, 54 to 57 per cent Al_2O_3, 3 to 5 per cent SiO_2, $5.50@$7; French, 56 to 59 per cent Al_2O_3, 2 to 5 per cent SiO_2, $6@$8.

BORAX—Per lb.: Carload lots, in bags, crystals, 2½c.; granulated or powdered, 2½c.; f.o.b. shipping point.

[1]CELESTITE—Per ton in carload lots: 90 per cent $SrSO_4$, finely powdered, $27.

CHALK—Per ton: Crude in bulk, c.i.f. *New York*, $4.75@$5.

CHINA CLAY (KAOLIN)—Per ton: F.o.b. *Virginia* mines, crude lump, No. 1, $7; crude No. 2, $5.50; washed, $8; powdered and air-floated, $8@$15; ground. $7@$15.

Florida, pressed pottery, bulk, $13; ground, No. 1, $20; No. 2, $15. Sprayed mineral flour in 100-lb. bags (bags extra), No. 1, $20; No. 2, $17. Market quiet.

Best grade, domestic, $16@$18, f.o.b. *Delaware* plants in carload lots.

Imported English, f.o.b. American ports: Lump, $13@$21; powdered, $40@$45.

DIATOMITE—Per short ton, f.o.b. producing plant:

Kiln-fired brick, $65; kiln-fired aggregate, ¼ in., $45; insulating powder, $25; natural aggregate, ¼ in., $18@$20; air-floated powder, $45; 80 to 85 per cent silica, 98 per cent through 200 mesh, $20 in carload lots.

EMERY—F.o.b. *Pennsylvania* and *New York* in 350-lb. kegs, per lb.: Greek Naxos, 6½c.; Turkish, 6½c.; Khasia, 6½c.; domestic, 3½c.

FELDSPAR—F.o.b. mine or grinding plant:

North Carolina, per long ton, No. 1 pottery grade, crude, $6.50@$7.50; No. 2, glass grades, $5@$6.

No. 1, pottery, 140 mesh, $16; 200 mesh, $18. No. 2, enamel, 20 mesh, $10.25@$12; 140 mesh, $13@$16; 200 mesh, $14.75@$18; all per short ton.

New Hampshire, per ton: Pottery grade, $7@$8. Best quality lump, $8@$9.

New York, per ton: f.o.b. cars, No. 1 crude, $9. Soda-potash feldspar, 140 mesh, first grade, $18 per short ton; 200 mesh, first grade, $20.

Maine, per ton: Best pottery grade, ground, $19. Market slow.

FLUORSPAR — Per ton: F.o.b. *Kentucky* and *Illinois* mines:

Gravel, not less than 85 per cent CaF_2 and not over 5 per cent SiO_2, $18. Foundry lump, 85-5, $20. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50 in bulk; $36.50 in bags or barrels. Acid lump, 98-1, $30 in car lots. Market steady.

New Mexico: 85-5 gravel, $16.50; 85-5 lump, $16.50; 93-3 lump, $23; ground, 98, $35.

Foreign spar, duty paid, $17, tidewater.

FULLER'S EARTH — Per ton, f.o.b. *Florida:* 16 to 30 mesh, $16.50; 30 to 60 mesh, $18; 16 to 60 mesh, $17; 60 to 90 mesh, $14; 100 mesh up, $7.

Powdered, import duty paid, $24@$25 per ton.

GARNET—Per ton; domestic, f.o.b. mines, $85.

Spanish grades, $60, c.i.f. port of entry.

GILSONITE — Per ton, carload lots, f.o.b. mines *Colorado:*

Selected grade, $33; seconds (mine run), $25.50. Normal market.

GRAPHITE—Per lb., f.o.b. *New York:*

Ceylon lump, 8@9c.; chip, 7@8c.; dust, 3@5½c.; Madagascar flake, 6½@7½c.

No. 1 flake, 8@16c.; fine ground, 5@15c. Ordinary fine ground, 4@8c.; high grade, 8@12c.; amorphous, 3@7c.

Crude amorphous graphite, $15@$35 per ton, according to grade.

GREENSAND—Per ton, f.o.b. cars, *New Jersey:* Screened and bagged, best grade, in carload lots, $15.

GYPSUM—Per ton, f.o.b. mill, depending upon location: Crushed, $1.50@$5; ground, $4@$9; agricultural, $4@$8; calcined, $4@$13.

IRON OXIDE (See Ocher)—Per lb.: Standard Spanish red, 3@4½c.; domestic earth, 2@4½c.

Mining Stocks—Week Ended August 31, 1929

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda Copper	New York	129	124	129	Jl. 13, Au. 19 Q	1.75
Andes Copper	New York	57½	55½	57½	Jl. 13, Au. 12 Q	0.75
Arizona Com	Boston	2½	2½	2½	Jl. 16, Jl. 31 SA	0.25
Calumet & Aris	New York	131½	129½	131	Se.6, Se.23 Q	2.50
Calumet & Hecla	Boston	47½	45½	46½	Au.31,Se.30 Q	1.00
Cerro de Pasco	New York	98½	95	97	Jl.11, Au. 1 Q	1.50
Con. Coppermines	N. Y. Curb	10⅝	9⅛	10		
Copper Range	Boston	25½	23½	25½	Je. 15, Jl. 15 Q	0.50
East Butte	Boston	3	2½	2½	Dec., 1919	0.50
Granby Con	New York	83½	79½	83½	Jl.12, Au.1 Q	1.75
Greene Cananea	New York	193	185½	192	Se.12, Oc.7 Q	2.00
Howe Sound	New York	68	65½	67½	Je. 29, Jl. 15 Q	1.50
Hudson Bay	N. Y. Curb	19½	18⅛	18⅛		
Inspiration	New York	46½	44⅛	46½	Se.9, Oc. 7 Q	1.00
Isle Royale	Boston	25½	24	24	Au. 31, Se.30	0.50
Kennecott	New York	91½	88⅛	90⅛	Au. 30, Oc. 1 Q	1.25
Magma Copper	New York	75½	69½	75	Je.28, Jl.15 Q	1.25
Mason Valley	N. Y. Curb	1½	1½	1½		
Miami Copper	New York	45½	44½	45½	Au. 1, Au. 15 Q	1.00
Mohawk	Boston	55½	53½	55½	Jl. 31, Se. 2 Q	2.00
Mother Lode	New York	3½	2½	3	Je. 13, Je. 29	0.20
Nevada Con	New York	48⅛	46	47⅛	Je. 14, Je. 29 Q	0.75
Noranda	N. Y. Curb	64½	63	63½		
Ohio Copper	N. Y. Curb	1½	1⅛	1⅛	Sept., 1926	0.03
New Dominion	Boston	*25	*20	*20	Dec., 1918	1.00
Phelps Dodge	New York	63	58½	60	Se. 4, Oc.1 Q	0.75
Quincy	Boston	49⅛	47½	48⅛	March, 1920	1.00
Roan Antelope	N. Y. Curb	50	44	49		
St. Mary's M. L.	Boston	41½	40	40½	Fe.25, Mr.12	2.00
Seneca Copper	New York	5½	5	5½		
Shattuck Denn	N. Y. Curb	17⅛	14⅛	16⅛		
Sherritt-Gordon	Toronto	7.60	7.30	7.35		
Tenn. C. & C.	New York	18	17⅛	17⅛	Au.31, Se.16 Q	0.25
United Verde Ex.	N. Y. Curb	18⅛	17⅛	17⅛	Jl. 2, Au. 1 Q	1.00
Utah Copper	New York	...	...	301	Je. 14, Je. 29 Q	4.00
Waite-Ack.-Mont.	Toronto	7.00	6.25	6.50		
Walker Mining	Salt Lake	5.75	5.60	5.60		
Wenden Copper	N. Y. Curb	1⅛	1	1		
LEAD, ZINC, SILVER						
Ahumada Lead	New York	1⅛	1⅛	1⅛		
Amer. Z. L. & S.	New York	28	26	26½	May, 1917	1.00
A. Z. L. & S., pfd.	New York	107½	103½	107½	Je.14, Jl. 1	1.50
Bunker Hill & S.	N. Y. Curb	40½	40	40	Au.22, Se.5 X	0.75
Butte Cop. & Zn.	New York	4⅛	4	4⅛		
Butte Cop. Con.	Boston Curb	*31½	*25	*25		
Butte & Sup.	New York	8⅛	8⅛	8⅛	Je. 14, Je. 29 Q	0.50
Callahan Zn-Ld.	New York	1⅛	1⅛	1⅛	Dec., 1920	0.50
Chief Consol.	Salt Lake	3.57½	3.50	3.55	Fe. 1, 1928 K	0.10
Consol. Ld. & Zn. "A"	St. Louis	10½	10	10½	Je.20, Jl.1 Q	0.25
Constitution	Spokane	*53	*50	*50		
Dayrock	Spokane	3.40	3.00	3.40	Je.20, Je.30	0.03
Dickens Consol.	Spokane	6⅛	6	6½		
Eagle-Picher	Cincinnati	17	16⅛	16⅛	Je. 30, Jl.15 Q	0.20
Eagle-Pich., pfd.	Cincinnati	...	...	103	Je. 30, Jl. 15 Q	1.50
Erupcion	Boston Curb	...	...	*12	Ja. 1, 1928 Q	0.07½
Eureka Bullion	Salt Lake	1.29	1.05	1.10		
Eureka Lily	Salt Lake	...	...	*33		
Eureka Standard	Salt Lake	...	...	1.42½		
Evans-Wallower	N. Y. Curb	17⅛	17⅛	17⅛		
Evans-Wal., pfd.	N. Y. Curb	...	...	84	Je.20, Jl. 1 Q	1.75
Federal M. & S.	New York	....	....	280	Je., 1927	10.00
Fed. M. & S., pfd.	New York	....	....	99¾	Au.23, Se.16 Q	1.75
Gladstone	Spokane	*5⅛	*4	*4		
Golconda	Spokane	*76	*66	*76	Je.15, Jl.1	0.02
Grandview	Spokane	*36½	*35	*35½		
Hecla Mining	N. Y. Curb	17⅛	17⅛	17⅛	Au.15,Se.15 Q	0.25
Highland-Surprise	Spokane	*15	*14½	*15		
Jack Waite	Spokane	* 9½	*9	*9		
Kootenay Florence	Spokane	*f5½	*14	*14		
Lucky Jim	Spokane	*9	*9	*9		
Lucky Tiger-C.	Kansas City	†3.25	†2.87½	....	Au. 1, Au. 10	0.02½
Mexican Premier	Spokane	2.24	2.24	2.24		
National Lead	New York	178½	150	167	Se. 13, Se. 30 Q	1.25
Natl. Lead, pfd. A	New York	140	138½	140	Au.30, Se. 14 Q	1.75
Natl. Lead, pfd. B	New York	....	....	116	Oc. 18, No. 1 Q	1.50
N. J. Zinc, new	N. Y. Curb	84⅛	83½	83½	Jl.20, An.10 Q	0.50
New Quincy	Salt Lake	2.59	2.37½	2.45	My.15, My.27 Q	0.10
Noble Five	Spokane	*55	*50	*55		
North Lily	Salt Lake	6.29	6.00	6.00	Jl.16, Jl.20 Q	0.25
Park Bingham	Salt Lake	7.00	5.50	6.50		
Park Utah	New York	6⅛	5⅞	6⅛	Je. 14, Jl. 10 Q	0.20
Pend Oreille	Spokane	5.25	5.00	5.00		
Rico Argentine	Salt Lake	*34	*33	*33	No. 30, De. 15 Q	0.03
Ruth-Hope	Spokane	*35	*30	*34		
St. Joseph Lead	New York	73⅜	68⅛	71⅛	Se.10,Se.20 QX	0.75
Sherman Lead	Spokane	*68	*65½	*68		
Silver King Coa.	Salt Lake	12.75	12.75	12.75	Je. 20, Jl. 1	0.25
Silversmith	Spokane	*7⅛	*7	*7	Oct., 1926 Q	0.02
Sunshine Mining	Spokane	5.38	5.25	5.32	Je. 10, Je. 20 Q	0.05
Tamarack-Custer	Spokane	*78	*76½	*78	Sept., 1924	0.25
Tintic Standard	Salt Lake	13.62½	13.50	13.50	Je. 17, Je. 29QX	0.30
Tonopah Belmont	N. Y. Curb	*.50	*.50	*.50	Oct., 1925	0.05
Treadwell-Yukon	Toronto	10.00	9.00	9.50		
United Zinc Smg.	N. Y. Curb	*68⅛	*68⅛	*68⅛		
Utah Apex	Boston	3⅜	3⅛	3⅛	May 15, June 1	0.25
Utah Met. & Tun.	Boston	1⅛	1⅛	1⅛	Dec., 1917	0.30
Whitewater	Spokane	*50	*50	*50		
Yellow Pine	Los Angeles	..	....	*8	Dec., 1925 QX	0.04
GOLD						
Alaska Juneau	New York	8⅛	7⅛	8⅛		
Barry-Hollinger	Toronto	*28	*27	*27		
Central Manitoba	Toronto	*41	*35	*41		
Creason Consol.	N. Y. Curb	*56½	*50	*50	Mr.30, Ap.10 Q	0.02
Dome Mines	New York	10⅛	9⅛	10	Jl. 20, Q	0.25
Golden Cycle	Col. Springs	†1.71	†1.68	....	Au.31,Se. 10 Q	0.04
Hollinger	Toronto	6.60	6.25	6.50	Au.23,Se.9 FW	0.50
Homestake	New York	80	80	80	Au.20, Au.26 H	0.50
Kirkland Lake	Toronto.	*77	*70	*74		
Lake Shore	Toronto	26.25	23.75	24.00	Je.1, Je.15 Q	0.20
McIntyre-Poro	New York	15	15	15	Au.1, Se.2 Q	0.25
Portland	Colo.Springs	†*6	†*5⅛	....	April, 1927	0.02
Rand Mines	New York	....	....	35	Au. 21,'29 Am.Sh.	1.51
Siscoe	Toronto	*91	70	84½		
Sylvanite	Toronto	*90	*85	*88		
Teck-Hughes	Toronto	7.30	6.10	6.25	Jl. 18, Au. 1	0.15
Tom Reed	Los Angeles	*70	*60	*70	Dec., 1926	0.02
Unity Gold	N. Y. Curb	1⅛	1⅛	1⅛		
Vipond Consol	Toronto	*95	*80	*85	April, 1927	0.03
Wright-Hargreaves	Toronto	1.66	1.50	1.50	Oc. 16, No. 1	0.02½
Yukon-Alaska	N. Y. Curb	....	....	35⅛		
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	18⅞	15⅛	18⅛		
Castle-Trethewey	Toronto	*30⅛	*30	*30		
Consol. Cortes	N. Y. Curb	....	....	*6½		
Dolores Esperanza	N. Y. Curb	....	....	*75	July, 1923	0.05
Keeley	Toronto	*49	*45	*45	Mr.15, 1928	0.04
Mining Corp.	Toronto	4.50	4.25	4.30	My.30, Je.13	0.12½
Montana-Idaho	Spokane	*6⅞	*5⅛	*6⅛		
N. Y. & Hond. Ros.	N. Y. Curb	16	16	16	Jl.17, Jl.27 QX	0.50
Nipissing	N. Y. Curb	2⅛	2⅛	2⅛	Je.29, Jl.20 Q	0.07½
Premier Gold	N. Y. Curb	1⅛	1⅛	1⅛	Je.13, Jl.3 Q	0.06
Tonopah Exten	N. Y. Curb	....	....	*10	April, 1925	0.05
Tonopah Mining	N. Y. Curb	....	....	2⅛	Ap. 7, Ap. 20	0.07½
United Eastern	N. Y. Curb	*50	*31½	*31½		
Yukon Gold	N. Y. Curb	*81½	*62½	*68½	June, 1918	0.02
IRON AND STEEL						
Bethlehem Steel	New York	139½	134⅛	138½	Oc. 18, No. 15 Q	1.50
Beth. Steel, pfd, 7%.	New York	123½	120½	123	Se.6, Oc.1 Q	1.75
Cleveland-Cliffs	Cleveland	97½	97½	97½	Je. 6, Je. 15	5.00
Colo. Fuel & Iron	New York	68⅛	63⅛	64⅛		
Colo. F. & I., 1st pfd.	New York	133	133	133	Au.10, Se.26, Q	2.00
Great Northern Iron.	New York	31⅛	30	30½	Dec.15, K	2.00
Inland Steel	New York	113	105½	107	Au.15, Se. 1, Q	1.87½
Republic I. & S.	New York	130½	124	129	My. 11, Je. 1, Q	1.00
Republic I. & S., pfd.	New York	111½	111½	111½	Je .12, Jl. 1, Q	1.75
Sloss-Sheffield S. & I.	New York	53	50	53	Mr. 11, Mr.20, Q	1.50
Sloss-Sheff. S. & I., pfd.	New York	70	69	69	Je.20, Jl.1, Q	1.75
U. S. Steel	New York	259⅛	251⅛	256½	Au. 29, Se. 28, Q	1.75
U. S. Steel, pfd.	New York	143⅛	141	143½	Au. 5, Au. 30, Q	1.75
Virginia I. C. & C.	New York	....	....	20	Jan., 1924	1.50
Virginia I.C.& C., pfd.	New York	....	....	42	Jl.16, 1928 SA	2.50
MISCELLANEOUS						
Aluminum Co. of Am.	N. Y. Curb	489	450½	464		
Alum.Co.of Amer., pf.	N. Y. Curb	107½	107⅛	107½	Mr.15, Ap.1, Q	1.50
American Metal	New York	75½	70½	70½	Au. 21, Se. 1 Q	0.75
Amer. Metal, pfd., 6%	New York	126	125	125	Au. 21, Se. 3 Q	1.50
Amer. Sm. & Ref.	New York	124½	118⅛	124	Je. 30, Jl. 12 Q	1.00
Amer. Sm. & Ref., pfd.	New York	135½	132⅛	135½	Au. 3, Se. 1 Q	1.75
Ang. Ch. Nitrate	N. Y. Curb	35⅛	34⅛	34⅛		
Asbestos Corp.	Montreal	10	9	9	Jan. 1926	1.50
Asbestos Corp., pfd.	Montreal	30	30	30	De. 31, Ja. 15 Q	1.75
Consol. M. & S.	Montreal	450	390	445	Je.29,Jl.15, SAX	6.25
De Beers Consol.	New York	21	21	21	Jl. 23, Jl.26, Q	0.96
Federated Metals	N. Y. Curb	36	32	34⅛	Je.25, Jl.5 Q	0.75
Freeport Texas	New York	51½	46⅛	51⅛	Jl. 5, Au.1 Q	1.00
Int. Nickel Can.	New York	56½	53⅛	54⅛	Au.31, Se.30 Q	0.25
Int. Nickel, pfd.	New York	122½	122½	122½	Jl.1, Au.1 Q	1.75
Mayflower Assoc.	N. Y. Curb	90⅛	88⅛	90⅛		
Metal & Mining	N. Y. Curb	20⅛	19⅛	20	Je.20, Jl.1 Q	0.30
Newmont	N. Y. Curb	222	211	221⅛	Je.29, Jl.15 Q	1.00
Patiño M. & E.	New York	42⅛	40⅛	41⅛	Au.31,Se.28,Am.Sh.	0.97
So. America G. & P.	N. Y. Curb	2⅛	2	2⅛		
Texas Gulf Sulphur	New York	74⅛	71⅛	72⅛	Se.2, Se.16 Q	1.00
U. S. Sm. R. & M.	New York	55⅛	53½	55⅛	Jl. 5, Jl. 15 Q	0.87½
U. S. Sm. R. & M., pfd.	New York	53	51⅛	52⅛	Jl. 5, Jl. 15 Q	0.87½
Vanadium Corp.	New York	85⅛	80⅛	82⅛	Au.1 Au. 15 Q	0.75

Toronto Standard Stock Exchange, Toronto, courtesy the Arthur E. Moysey Co.; Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Standard Stock Exchange, Spokane, courtesy Pohlman Investment Company.

*Cents per share. †Bid or asked. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. K, Irregular. I, Initial. R, Resumption. X, Extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

LONDON QUOTATIONS—WEEK ENDED August 20, 1929

	High	Low	Last	Date	Amount
Alaska Mexican ($5)	20/—	20/—	20/—		
Alaska Treadwell (25)	55/6	55/—	55/—	Nov., 1926	4 p.c.
Aramayo Mines (25 frs.)	60/—	58/9	58/9	Aug., 1929	5 p.c.
Burma Corp (10 rupees)	18/6	17/4½	17/6	July 1929	9 annas*
Bwana M'Kubwa (5s)	27/10½	23/9	27/—		
Camp Bird (2s)	2/—	1/9	2/—	April, 1928	16⅔ p.c.
El Oro (5s)	3/—	2/8½	3/—	Nov., 1924	2½ p.c.*
Frontino & Bolivia (£1)	7/6	7/1½	7/6	Jan., 1929	3⅓ p.c (c)
Mexican Corpn. (£1)	15/11½	15/—	15/9		
Mexico Mines of El Oro (£1)	6/—	6/—	6/—	Dec., 1926	3⅓ p.c.*
Mount Isa (£1)	40/—	38/1½	40/—		
N'Changa Copper Mining. (£1)	81/3	66/10½	72/6		
Oroville Dredging (4s)	2/—	1/9½	2/—	Nov., 1928	31½ p.c
Rhodesian Congo Border (£1)	230/—	202/6	217/6		
St. John del Rey (£1)	16/13	15/6	15/6	Apr., 1929	7½ p.c.
San Francisco Mines (10s)	34/10½	34/3	34/7½	June 1929	15 p.c
Santa Gertrudis (£1)	10/—	9/6	9/6	July 1929	7½ p.c.
Selukwe (2s. 6d.)	6/1½	6/—	6/—	April, 1917	6½ p.c.
S. Amer. Copper (2s.)	3/1½	2/10½	2/10½	Nov. 1917	75 p.c.
Tanganyika (£1)	67/3	60/10½	67/6	July, 1928	5 p.c.
Union Miniere du Haut-Katanga (Brussels)	11,910	11,775	11,910	April, 1929	300 fr. (‡)

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian francs and free of taxation. (d) U. S. Dollars. (c) July, 1929, ex ½d. return of capital. (e) on original £1 shares.